3

SCIENCE

JANUARY 2, 1953

VOLUME 117 NUMBER 3027

Contents

Some Aspects of Neutron Single Crystal Analysis: *Ray Pepinsky* — 1

Hugo Iltis: 1882–1952: *L. C. Dunn* — 3

News and Notes — 4

Technical Papers

The Disposition of Intraperitoneally Injected Foreign Matter in Amphibia: *Thomas W. Easton* — 8

Radioactivity Induced in Yeast by 100 Mev X-Radiation: *G. C. Baldwin* and *Leonard B. Clark* — 9

Developmental Forms of Vaccinia Virus: *William H. Gaylord, Jr.*, and *Joseph L. Melnick* — 10

Crown Gall Suppression by Anti-Auxin: *Paul E. Waggoner* and *A. E. Dimond* — 13

The Effect of Triphenyltetrazolium Chloride on Oat Embryo Respiration: *Glyn O. Throneberry* and *Frederick G. Smith* — 13

Stabilities of Metal Derivatives of *o*-Substituted Azo Dyes: *Fred A. Snavely* and *W. Conard Fernelius* — 15

Comments and Communications

S. R. Bose; M. W. Garretson; Joel W. Hedgpeth, Robert J. Menzies, Cadet H. Hand, and *Martin D. Burkenroad; Francis Hemming; Akira Horita* and *Theodore C. West*; and *Phillip H. Mann* and *Italo Fratta* — 16

Book Reviews

Microscopic Histochemistry; The Advance to Social Medicine; The Principles of the Control and Stability of Aircraft; Statistical Theory with Engineering Applications; Prelude to History; Frost Action in Soils — 19

Scientific Book Register — 22

Standard Samples — 3

Meetings & Conferences — 10

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

This is a close-up view of a rack of microslides undergoing staining on the **Autotechnicon.** The process is *completely automatic,* and geared to split-second timing. The slides are now descending into one staining-fluid beaker: at the precise moment when the required immersion period has been completed, they will be promptly raised, and rapidly shifted to the next station in the sequence . . . automatically, infallibly. During immersion the slides are rotated gently within the fluid, thus assuring rapid, even stain permeation.

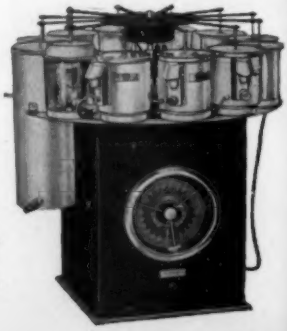
Any technique prescribed by the pathologist may be employed. Once the master dial has been set for the correct time intervals, the method may be repeated time after time, without the minutest variation, and independent of any supervision. Each batch of slides put through is stained in *exactly* the same way, resulting in unvarying uniformity.

Autotechnicon staining is not only convenient, dependable, time-saving . . . it produces "Sunday-best" slides . . . *every day.*

Autotechnicon

Trade Mark Registered U. S. Patent Off.

automatic tissue processing . . . fixation, dehydration, infiltration, washing, staining



THE TECHNICON COMPANY
215 East 149th Street • New York 51, N. Y.

A New High in Metering Efficiency

MAISCH

Stainless Steel Metering Pumps

- Variable Capacities—0 to 3.2 gal/min.
- Fixed capacity units .175 to 4.8 gal/min.
- Sterilizable by steam autoclaving.
- Made of non-pyrogenic materials.
- Pump instantly detachable.
- Easily disassembled for cleaning.
- Non-pulsating positive displacement.
- Self-lubricating oilless bearings.
- Automatic volumetric dispensing controls available.

These pumps are designed and built for those requiring the utmost in accuracy and dependability in the metering of small volumes of liquid. They provide for precision control in the dispensing of hot or cold viscous or non-viscous liquids such as soaps, oils, perfume, liquid fat, wax, glue, beverages, fruit juices and numerous chemicals. And they have been found equally valuable for the control of biological fluids and other sterile solutions.

The flow of the Maisch Pump is continuous, smooth and non-pulsating. Variable speed is instantly adjustable to the exact amount desired from zero/ml sec to the maximum capacity of the pump. The simple design permits easy disassembly for cleaning and sterilizing.

Materials used in Maisch Pumps are non-pyrogenic and remain sterile while dispensing sterile liquids. They resist corrosion and chemical reaction of most liquids and do not contaminate or otherwise affect the quality and flavor of beverages.

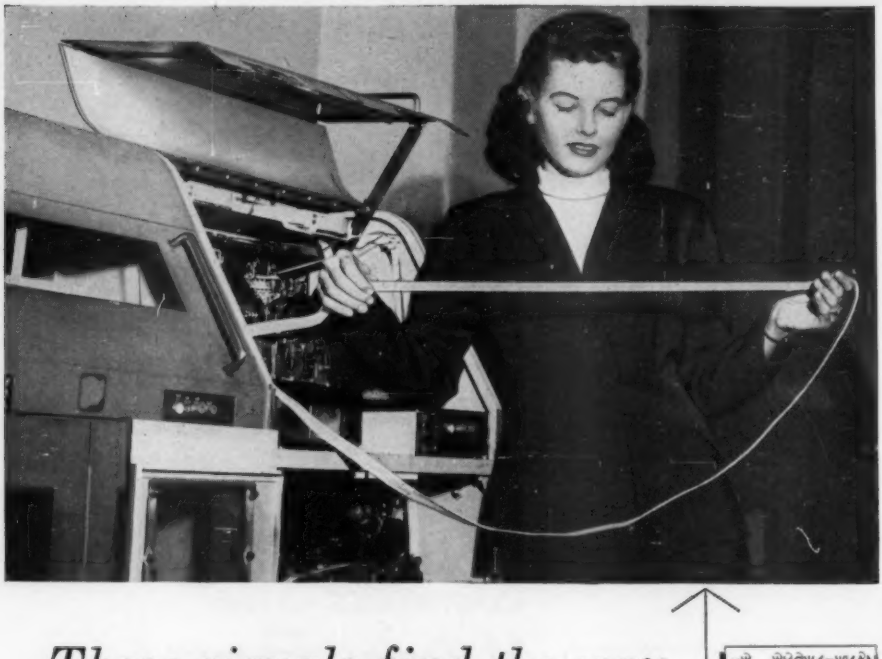
Maisch Pumps are available in a wide variety of types and capacities ranging from zero to 4.8 gallons per minute. Write today for complete details and prices.

cenco

. . . one dependable source of supply for everything you need in scientific instruments and laboratory supplies. Over 15,000 items . . . 14 branch offices and warehouses.

CENTRAL SCIENTIFIC COMPANY
1700 IRVING PARK ROAD • CHICAGO 13, ILLINOIS
CHICAGO NEWARK BOSTON WASHINGTON DETROIT SAN FRANCISCO
SANTA CLARA LOS ANGELES TORONTO MONTREAL VANCOUVER OTTAWA

REFINERY SUPPLY COMPANY
621 EAST FOURTH STREET • TULSA 3, OKLAHOMA
2215 McKINNEY AVENUE • HOUSTON 3, TEXAS



These signals find the way

SENDING

RECEIVING

When you dial a telephone number, high-speed switching mechanisms select your party and connect you. Through a new development of Bell Telephone Laboratories, similar mechanisms do a similar job in private wire teletypewriter systems which America's businesses lease from the telephone company.

Company X, for example, operates an air transportation business with offices all over America. At one office, an operator wishes to send a message, let us say, to Kansas City. Ahead of the message, she types the code letters "KC". The letters become electric signals which guide the message to its destination.

Any or all stations in a network, or any combination of stations, can be selected. Switching centers may handle 50 or more messages a minute ... some users send 30,000 messages a day. Delivery time is a few minutes.

Defense manufacturers, automobile makers, airlines and many other American businesses are benefiting by the speed and accuracy of the new equipment—another example of how techniques developed by the Laboratories for telephone use contribute to other Bell System services as well.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.

SCIENCE

Gladys M. Keener
Executive Editor

AAAS EDITORIAL BOARD
(Terms expire June 30, 1953)

Howard A. Meyerhoff, **Chairman**
William R. Amberson — Bentley Glass
Wallace R. Brode — Karl Lark-Horovitz
Walter J. Nickerson
F. A. Moulton, Advertising Representative

Standard Samples

ESTABLISHED forty-seven years ago as an aid to analytical chemistry, the standard sample program of the National Bureau of Standards has grown to include a much broader range of scientific work. Standard samples are now certified by the bureau not only for chemical composition but for such properties as density, melting point, viscosity, acidity, color, gloss, index of refraction, and heat of combustion. New standards are constantly being added to meet the increasing requirements of science and industry. Recent additions include a number of standard samples of artificially produced radioactive isotopes for use in nuclear physics, biochemical research, and allied fields. The bureau is now issuing approximately 25,000 standard samples annually, representing more than 500 kinds of materials.

The NBS standard samples are materials that have been carefully analyzed, or the physical properties of which have been precisely determined, at the bureau and sometimes in other laboratories. About 200 of the 500 standard materials are certified for chemical composition. The majority of these are samples of metals and alloys; they are used extensively to monitor the thousands of analyses made daily in industrial laboratories to control the quality of steel and other commercial products. The standards of chemical composition serve also as a guide to the research analyst engaged in developing new methods of analysis or in determining the composition of unknown materials. Some 70 of the composition standards have been prepared specifically for use in spectrographic analysis.

Smaller in number, but of great value to the chemist, are the standards that are certified with respect to their quantitative behavior in fundamental chemical reactions, especially those between bases and acids, and those involving oxidation and reduction. Standards of pH provide solutions of known and accurately reproducible acidity. Other materials, certified for heat of combustion, govern the innumerable measurements that are made of the heating value of fuels.

Standard samples are used to check and maintain the accuracy of many kinds of measuring instruments, such as polarimeters and refractometers. A number of metals, issued with certified melting points, serve to calibrate temperature-measuring instruments in the metallurgical, ceramic, and other industries.

There are also about 200 samples of hydrocarbons issued as "pure substances" and certified with respect to their degree of purity. This group was developed during the war years and immediately afterward in response to the need for standards to calibrate the instruments used in controlling the production of synthetic rubber and special fuels for military aviation.

Radon, γ-ray, and β-ray standards are used to check radiation-detecting instruments and to further research in radioactivity. Recent developments in this group are radioactive standards of carbon 14, iodine 131, phosphorus 32, and cobalt 60.

The NBS standard sample program began in 1905, when the American Foundrymen's Association turned over to the bureau its four sets of standardized pig-iron samples. As the analysis and distribution of these samples proceeded, the need for additional standards became apparent. However, growth of the program was necessarily gradual, because its usefulness depended in a large degree on the confidence that could be placed in the reliability of each new kind of sample. Attainment of this confidence has required not only many painstaking measurements and analyses but studies of stability over a period of years and research to determine the extent to which uniformity could be established in a group of samples. In this work the bureau has had the cooperation of the leading technical societies of the country. These organizations also perform a valuable service in suggesting future lines of activity in the standard sample program.

EDWARD WICHERS

National Bureau of Standards

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

All correspondence should be sent to SCIENCE, 1515 Massachusetts Ave., N.W., Washington 5, D. C. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. Four weeks' notice is required for change of address, and an address stencil label from a recent issue must be furnished. Claims for a missing number will be allowed only if received within 60 days from date of issue.

Annual subscriptions, $7.50; single copies, $.25; foreign postage, outside the Pan-American Union, $1.00; Canadian postage, $.50. Special rates to members of the AAAS.

The AAAS also publishes THE SCIENTIFIC MONTHLY. Subscription and advertising rates on request.

Cable address: ADVANCESCI.

RESEARCH BIOCHEMICALS

For

INVESTIGATIONAL USE

AMINO ACIDS

A complete selection of more than 90 amino acids of maximum purity including:

DL ALPHA ALANINE
BETA ALANINE
L ALANINE
DL ALPHA AMINO-n-BUTYRIC ACID
L ARGININE (HCl, Free Base)
ASPARAGINE (L, DL, D)
ASPARTIC ACID (L, DL, D)
BETAINE
DL CITRULLINE
CREATINE
CREATININE
CYSTEINE (HCl, Free Base)
CYSTINE (L, DL)
DL DOPA
DJENKOLIC ACID
DL ETHIONINE
GLUTAMIC ACID (L, DL, HCl)
GLUTAMINE
GLYCYL-GLYCINE
HISTIDINE (L, DL, D)
DL HOMOCYSTEINE
DL HOMOCYSTINE
HYDROXY-L-PROLINE
ISOLEUCINE (L, DL, D)
LEUCINE (L, DL, D)
LYSINE HCl (L, DL)
METHIONINE (L, DL, D)
METHIONINE SULFOXIDE
DL NORLEUCINE
DL NORVALINE
ORNITHINE HCl (DL, L)
PHENYLALANINE (L, DL, D)
PROLINE (L, DL)
SARCOSINE
DL SERINE
B PHENYL SERINE
TAURINE
THREONINE (L, DL, D)
DL ALLO THREONINE
TRYPTOPHANE (L, DL, D)
TYROSINE (L, DL)
VALINE (L, DL, D)

ALSO—A SELECTION OF 20 PEPTIDES

WRITE FOR

NEW CATALOGUE

#S 975

Listing over 600 Research Biochemicals

Nutritional Biochemicals Corporation

CLEVELAND 28, OHIO

Paper Partition

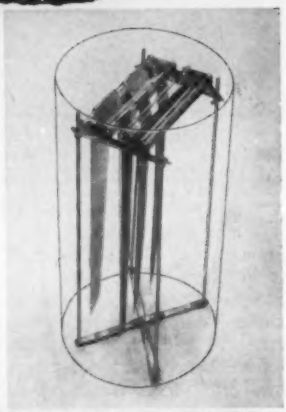
CHROMATOGRAPHY

Equipment

A new and more complete line of paper chromatographic equipment carefully engineered for use in this new field of analysis.

CHROMATOCABS
STEEL OR GLASS RACKS
DENSITOMETERS
ULTRAVIOLET LAMPS
INDICATOR SPRAYS
DISC CHAMBERS
DRYING OVENS
MICRO PIPETS
CLIPS

Prompt Delivery



Write for Catalog

RACK & SOLVENT ASSEMBLIES

Research Equipment CORPORATION

1135 THIRD STREET, OAKLAND 20, CALIFORNIA DEPT. S

CANCER the subject of outstanding A. A. A. S. Symposium Volumes:

MAMMARY TUMORS IN MICE, 1945:

10 contributors, viii + 223 pages, 7½ x 10½, clothbound, double column, illustrated, $3.50. Cash order price to A.A.A.S. members, $3.00. Coordinated knowledge of cancer of the breast in mice. It cannot fail to stimulate interest and further research efforts in one of our most fascinating and important biological problems. Prepared by members of the staff of the National Cancer Institute.

APPROACHES TO TUMOR CHEMOTHERAPY, 1947:

93 contributors, x + 442 pages, 7½ x 10½, clothbound, double column, illustrated, $7.75. Cash order price to A.A.A.S. members, $6.50. A progress report, addressed largely to future workers. An important and trustworthy reference book. Planned under the auspices of National Cancer Institute, Memorial Hospital of New York, Sloan-Kettering Institute for Cancer Research, Lankenau Institute of Philadelphia, and others.

TO: AAAS PUBLICATIONS
1515 Mass. Ave., N.W., Washington 5, D. C.

Enclosed is $..... Please accept my order for

☐ MAMMARY TUMORS in MICE
☐ APPROACHES to TUMOR CHEMOTHERAPY

Sanborn two-channel instruments for the simultaneous recording of two physiological phenomena*

* Phonocardiogram of DIAGNOSTIC quality WITH High-deflection-speed electrocardiogram

OR, two other physiological phenomena in combination.

PHOTOGRAPHIC

Twin-Beam

CARDIETTE

Equipped with one ECG amplifier and one heart sound amplifier. Both are *removable* and *interchangeable.* Additional ECG amplifier available if recording of 'cardiograms and/or other physiological phenomena in combination is desired. Paper speeds 2.5, 25 and 75 mm/sec. AC power operated. 6cm. bromide paper.

* Electrocardiogram WITH one other physiological phenomenon

OR, two other physiological phenomena in combination.

DIRECT WRITING

Twin-Viso

CARDIETTE

Each of the two channels may include *either* a Carrier Type or General Purpose Amplifier, or the latter in combination with either ECG or DC Preamplifiers. Amplifiers and preamplifiers *interchangeable.* Five dual sets of speeds —5 and 0.5, 10 and 1, 25 and 2.5, 50 and 5, 100 and 10 mm/sec. 5 inch recording Permapaper.

For further information on either or both of these instruments, address

Sanborn Company CAMBRIDGE 39, MASSACHUSETTS

Now available . . .

Adenosine Triphosphate (ATP); Amygdalin; Amylase; Animal Lecithin; Ascorbic Acid Oxidase; Bacitracin; BAL; Biotin, cryst.; Caffeic Acil; Carotene, cryst.; Catalase; Cellulase Chlorogenic Acid; Chorionic Gonadotropin; Circulatory Hormone; Colchicine; Cytidylic Acid; Cytochrome C; Dehydroascorbic Acid; Diacetonamine; Dihydroxyacetone; Dihydroxyphenylalanine (DOPA); Dipyridyl; Edestin; Emulsin; Erythritol; N-Ethylpiperidine; Fibroin; Folic Acid; Galacturonic Acid; Gentisic Acid; Girard Reagents P and T; Gliadin; Glucose Pentaacetate; Glucuronic Acid; Glyceraldehyde; Glyceric Acid; Heparin; Hordenine; Hyaluronidase; Hydrindene; 2-Hydroxyadipaldehyde; Humulon; Indan; Isoascorbic Acid; Isopropylarterenol; Kojic Acid; Kynurenic Acid; Lanthionine; Lipase; Lysozyme; Lyxose; Malononitrile; Maltase; Melezitose; Mesobilirubinogen; Muscle Adenylic Acid; Myanesin; p-Nitrophenylphosphate; Nucleoprotein; Orcinol; Pancreatin; Pantothenyl Alcohol; Penicillinase; Peroxidase; Phenazine; Phenylpyruvic Acid; Phloridzin; Phosphorylase; Piperin; Porphyrindine; Protamines; Protoporphyrin; Pyridoxal; Pyridoxamine; Pyrocatechuic Acid; Pyruvic Aldehyde; Ribonuclease; Saccharic Acid; Salmine; Serine Phosphoric Acid; Spermidine; Spermine; Thioacetic Acid; Thiocytosine; Thyroxine; Trigonelline; Triphenyltetrazolium Chloride; Tripyridyl; Trypsinogen; Tyrosinase; Tyrothricin; Urease; Uricase; Uridine; Vitellin; Xanthosine.

Ask us for others!

DELTA CHEMICAL WORKS

23 West 60th St. New York 23, N. Y.

Telephone Plaza 7-6317

Diversified Uses . . .

Uniform Results . . .

CF RATS

• For years CF RATS have been used with outstanding success in a wide range of research . . . a fact well evidenced by the continually increasing demand for them.

• Should your work require the use of rats we urge that you consider the proven dependability and versatility of CF RATS.

• For further information please write:

CARWORTH FARMS, INC.

NEW CITY, N. Y.

ELECTROPHORESIS-SCHLIEREN APPARATUS

complete multi-purpose units for . . .

Routine clinical analysis
Adsorption chromatography
Electrophoresis research & analysis
Macro-preparative work
Industrial process control
Diffusion & turbidity measurements
Mechanical dialysis

Both models of Aminco Electrophoresis Apparatus constitute complete electrophoresis laboratories in single, compact units. They incorporate precise schlieren optics in an air-conditioned space, automatic integral refrigeration system, built-in line-voltage-regulated and current-stabilized high-voltage power supply, rapid internal dialysis facilities, and temperature-regulated water bath.

Aminco-Stern universal research model for large output and a wide variety of sample volumes.

BULLETIN 2175-K

Aminco portable model for routine research and clinical use on a smaller scale.

BULLETIN 2281-K

AMINCO *Laboratory Instruments*

AMERICAN INSTRUMENT COMPANY, INC.

Silver Spring, Maryland • In Metropolitan Washington, D. C.

What GENERAL ELECTRIC People Are Saying

E. DALE TROUT

JOHN VLACH

X-Ray Department

NEW TOOL FOR MEDICAL RESEARCH: Completion of the Cobalt-60 irradiator marks the beginning of an era which medical researchers look hopefully toward.

Pile-produced isotopes for teletherapy must, among other things, emit gamma radiation and have a half-life longer than 150 days. Radioactive Cobalt-60 emits gamma radiation, has a half-life of 5.3 years, and is obtained from the waste by-products of plutonium production. A 1000-curie Cobalt-60 source should produce a radiation intensity about equal to 1500 grams of radium.

Availability and cost of the source will generally determine the future of Cobalt-60 teletherapy. Until it becomes available at much lower cost, or another artificial source is accessible, the super-voltage x-ray machine will not be supplanted by artificial radioactive sources.

General Electric Review
November, 1952

★

R. BLOUNT

Lamp Division

ELIMINATION OF TV CAMERA LIMITATIONS: TV pictures with three-dimensional qualities are within reach of TV engineers today. With proper lighting methods and equipment this goal is immediately obtainable.

The following methods will help in obtaining required brightness differences: 1) providing 100 vertical foot-candles of base light; 2) developing form by applying modeling light 30 to 50 per cent greater than base light; 3) separating actors from the background by applying backlight 50 to 100 per cent greater than the base light; and 4) adjusting background brightness with respect to foreground subjects.

Television Studio Clinic
Cleveland, Ohio

H. A. WINNE

Engineering

THE ATOMIC-ELECTRIC POWER INDUSTRY: It is unfortunate that our entry into the atomic energy era was by way of the atomic bomb—and when I say that I am not thinking at all of the use of the bomb. It seems to me that we may have entered the development path at the wrong end.

Most people undoubtedly feel that atomic energy development is so vastly expensive that it would not have come about unless government undertook it.

We certainly would not have had the atomic bomb, at the present time, nor submarine atomic power plants scheduled for the near future, without government financing, but I am not at all sure that we shall have a sound atomic-electric power industry sooner than we would have had if this development had taken a more normal course in the interested private industries.

Various studies now under way contemplate the possible construction of atomic-electric power plants, designed to produce plutonium, with electric power as more or less of a by-product.

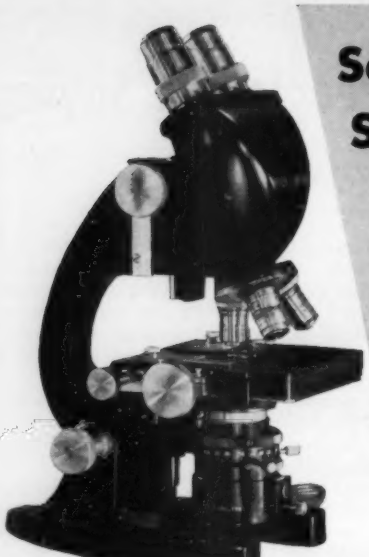
This situation would not constitute a sound basis for an atomic-electric power industry. Certainly, barring war, at some time in the future our atomic bomb stockpile should reach an adequately high peak, and the government would not then be justified in continuing to purchase the plutonium output.

Atomic-electric power will be really economically sound only when it can compete with conventional electric power without requiring a government-supported weapons market. It could not do that today—unless in some very peculiar and unusual circumstances—nor, in my opinion, for a good many years to come.

AIEE Machine Tool Conference
Albany, New York

You can put your confidence in

GENERAL ELECTRIC



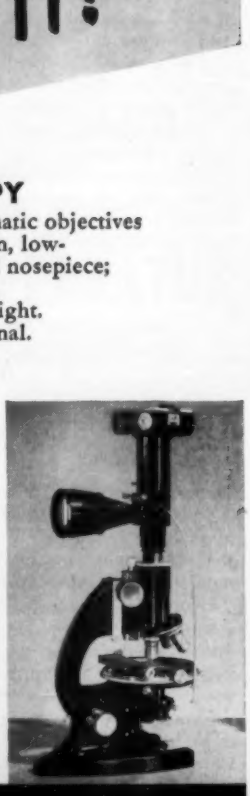
See it better . . .
See it more easily . . .

ANY WAY YOU LOOK AT IT!

● **IN VISUAL RESEARCH MICROSCOPY**
Complete line, with widest choice of superb apochromatic objectives for general and highly specialized studies. Slow-motion, low-position fine focusing adjustment; permanently aligned nosepiece; inclined parallel eyepieces, for strain-free observation. Adaptable to phase contrast, dark field and polarized light. Exclusive variable intensity Panfocal Illuminator, optional.

● **IN ALL MONOCULAR APPLICATIONS**
Quickly interchangeable monocular tube adapts instrument for photomicrography, measuring, micro-projection, etc. Widest range of accessories, for *maximum* use.

● **IN ON-THE-SPOT PHOTOMICROGRAPHY**
Viewing head and camera fit monocular tube. Make your own projection slides, "work-in-progress" records—completely independent of photomicro lab.



WRITE for demonstration and catalog. Bausch & Lomb Optical Co., 642-34 St. Paul St., Rochester 2, N.Y.

B&L Bausch & Lomb *Research* Microscopes

Some Aspects of Neutron Single Crystal Analysis

Ray Pepinsky[1, 2]

Department of Physics, Brookhaven National Laboratory, Upton, Long Island, New York

THIS PAPER PRESENTS a few observations on single-crystal analysis, based upon experience with the method at the Brookhaven National Laboratory reactor during part of the summer of 1952, and a comparison of neutron and x-ray scattering.

Fourier Methods in Neutron Analysis

One previous writer (*1, 2*) has held that Fourier methods cannot be used for crystal analysis from neutron-scattering data because of the nature of the nuclear form factors. Thewlis (*3*) has suggested that the application of a strong artificial temperature correction could overcome this difficulty. Other convergence factors could also be used (*4, 5*), however, to provide better approximations to the correct density distributions. But it should be noted that nonconvergence is a problem only for simple structures in which most atoms are in special positions. In such cases Fourier methods are likely to be unnecessary anyway. As indicated by Wilson and co-workers (*6*), the Fourier coefficients for random structures comprised of point atoms, none of which possesses excessively large scattering power, fall off with increasing scattering angle in a manner depending upon the crystal symmetry. When the effects of thermal oscillations are superposed on this convergence, it can be expected that little additional convergence factor will be required for complex structures.

This conclusion has been borne out very well in the case of the $(h, k, 0)$ projection of KH_2PO_4, single-crystal neutron-scattering data for which was recently collected by B. C. Frazer and the writer at the Brookhaven National Laboratory reactor. The structure, and particularly the (0, 0, 1) projection, is actually not a favorable one from the point of view of the Wilson statistics. Phosphorus and potassium atoms are in special positions on the four-fold axes and are superposed in the (0, 0, 1) projection. Nevertheless, the observed structure factors fall off sufficiently fast with increasing $\frac{\sin\theta}{\lambda}$ to permit computations of excellent Patterson and Fourier maps. The Patterson map showed well-defined negative peaks representing the vectors between negatively scattering hydrogen and positively scattering P, K, and O nuclei, and well-defined positive peaks for the other interatomic vectors. Approximate hydrogen positions could be assigned, then, directly from the Patterson map. The Fourier map for the nuclear density distribution shows the P, K, and O nuclei, and the protons appear in double minima between the O—H . . . O bonded oxygens, with apparently half a proton, on the average, occupying each of the doubled positions. Patterson and nuclear density maps were also computed using calculated coefficients, assuming a single H-minimum between O—H . . . O oxygens, and with temperature-corrected scattering factors for the P, K, and O atoms as deduced from the x-ray analysis of KH_2PO_4 (*7*) and a temperature correction for the H-atoms as found by Levy and Peterson in NH_4Cl (*8*). These were in good agreement with the maps utilizing observed data, except for the appearance in the nuclear density maps of the doubled (disordered) hydrogen positions.

The statistical convergence of neutron-scattering factors in more or less random structures, coupled with the effects of natural thermal oscillation or artificial convergence factors, will evidently permit the rather general use of Fourier methods in neutron crystallography. A much more optimistic view of the power of the neutron technique is thus permissible than has been presented heretofore.

Examples of Negligible Influence of Extinction

It has also been held that the effects of extinction may seriously limit the size of crystals that can be used in single crystal analyses (*9, 10*). In the case of the KH_2PO_4 study reported above, a cylindrically ground *c*-axis crystal about 3 mm in diameter and 1 cm long was utilized. The crystal was dipped several times into liquid nitrogen, in order to carry it back and forth through the ferroelectric transition point from tetragonal to orthorhombic symmetry. Extinction effects were found to be negligible. It is questionable whether the low-temperature treatment was necessary, but it was employed because of the limited time available, which would not have sufficed to permit repetition of the measurements. The smallness of the influence of extinction has been reported previously by Levy and Peterson in the case of NH_4Cl single crystals (*8*).

[1] Present address: Department of Physics, The Pennsylvania State College, State College.

[2] The writer is deeply indebted to Andrew McReynold and his group at the Brookhaven National Laboratory for furnishing facilities with which the KH_2PO_4 analysis was possible, and for continual aid during the investigation. Discussions with Dr. McReynold, L. Corliss, J. Hastings, and R. Weiss were extremely helpful, as was correspondence with H. Levy and S. W. Peterson, of the Oak Ridge National Laboratory.

Phase Determination from Neutron Data

It is well known that the chief difficulty in x-ray structure analysis is the absence of direct information on the phases of the scattered x-rays. Methods based upon nonnegativity and "atomicity" of the electron distribution permit the deduction of some phase information (*11, 12*), and "marked atom" methods (heavy atoms, with or without isomorphous replacement) have been particularly advantageous (*13*).

In their first paper on algebraic relations, Harker and Kasper (*14*) pointed out that their phase-determining conditions were strengthened if the observed crystal structure factors were divided by the value for the same scattering angle of the atomic structure factor, taking an "average" type of atom in the structure and correcting the "average-atom" factor for temperature oscillation. The effect of this modification of the observed structure-factor amplitudes is to simulate Fourier coefficients for a point-atom structure without thermal vibrations; and such point-atom coefficients afford the strongest phase-determining conditions. It is unfortunately true that, in the majority of structures involving different kinds of atoms, the structure-factors for these atoms are not sufficiently similar in form to permit choice of an "average" atom that will lead to accurate coefficients for the point atom structure; and thus there is introduced into the already complex phase-determination algebra the further complication of inexact data.

It is interesting to note that neutron-scattering factors are just those corresponding to thermally oscillating point atoms; hence the only correction needed to reduce the Fourier coefficients to those for a distribution of fixed point-scatterers is to correct for the temperature effects. This can generally be done with much greater accuracy than is possible in the correction for atomic structure factors, and it must be done in both cases (for either nuclear scatterers or electron cloud distributions). Therefore, neutron-scattering data are more amenable to algebraic phase-determining methods than are x-ray data.

Marked Atom Methods

The effects on structure analysis of variation of neutron-scattering power for the various nuclei in the periodic table have been discussed elsewhere. A few such effects should be particularly noted here. In one sense the "heavy-atom" method of x-ray analysis is possible to a much more limited extent with neutrons, since the variation of scattering cross sections is random throughout the periodic table, and the coherent scattering cross sections do not vary much from one element to another. Striking use of the isomorphous replacement method is possible with replacement of hydrogen by deuterium. The coherent scattering cross section here changes from -0.38 for H to $+0.65$ for D. The incoherent scattering of H may be troublesome in some cases, although to a much lesser extent with single crystals than in powder diffraction —as Levy and Peterson (*8*) and others have pointed out. The small influence of H-atoms upon x-ray scattering is, of course, an advantage in many-atom organic structures, where location of nonhydrogen atoms is already difficult and the structures would probably be impossible to determine if many hydrogen parameters would also have to be established before structure factors could be calculated. In structures where hydrogen positions are important, the obvious procedure is to determine non-H atom coordinates with x-rays, and then locate H (or D) atoms with neutrons.

Isomorphous replacement depends, of course, upon both chemical and packing-size similarities in the replaceable atoms. If enriched isotopes were readily available, isotopic replacement would be very advantageous in the cases (including H) shown in Table 1. Data for this table and for the discussion below are from C. Shull and E. O. Wollan, of the Oak Ridge National Laboratory (*15*).

Whereas replacement of halogens is very useful in the x-ray isomorphous methods, Cl is the only outstandingly heavy scatterer among them for neutrons. S (0.31) and Se (0.89) are good pairs for neutron studies. Na or K (0.35), Rb (0.55), Cs (0.49), and Tl (0.75) are not as advantageously different as in the x-ray case; but replacement of NH_4 by K, Rb, or Tl should provide interesting and perhaps useful effects. Ca, Sr, and Ba are not sufficiently different to be useful in the neutron case. Ti (-0.38) and Zr ($+0.62$) make an extremely good pair for the isomorphous replacement method.

TABLE 1

Isotopes for Use in Isomorphous Replacement Method

Isotope	Scattering factor $\times 10^{-12}$ cm	Isotope	Scattering factor $\times 10^{-12}$ cm
^{1}H	-0.38	^{57}Fe	0.23
$^{2}H = D$	$+0.65$	Fe*	0.96
^{6}Li	0.7	^{58}Ni	1.44
^{7}Li	-0.25	^{60}Ni	0.30
Li*	-0.18	^{62}Ni	0.87
Ca*	0.49	Ni*	1.03
^{44}Ca	0.18	^{107}Ag	0.83
^{54}Fe	0.42	^{109}Ag	0.43
^{56}Fe	1.01	Ag*	0.61

* In natural abundance ratio.

Scattering with negative phase occurs for H, ^{7}Li, and Li in natural abundance ratio, Ti, Mn, and ^{62}Ni. As in the case of the KH_2PO_4 Patterson map, vectors between positive and negative scattering centers will appear in the Pattersons as negative peaks; all other interactions produce positive peaks. The aid that this provides in identification of the atoms responsible for the peaks is obvious.

It must be borne in mind that the algebraic relations in x-ray analysis which depend upon nonnegativity of the distribution of scattering material will *not* apply without modification when negative scattering centers are present in the neutron case. *Boundedness* of the

function can, however, be utilized (*16*); and when the position of negative scatterers is known, but the distribution of other nuclei is not yet established, a set of Fourier coefficients for the negative scatterers alone can be computed, and these can be subtracted from the corresponding coefficients for the complete crystal. Relations arising from nonnegativity can then be applied.

Conclusions

Neutron diffraction has been regarded by some workers as a supplement to x-ray methods, to be used chiefly for structure refinement or location of light x-ray scatterers among heavy scatterers. There are cases, however, where neutron methods should provide more direct approaches to an unknown structure from the outset. Although it has been stated that Fourier methods will not be possible with neutron data, it is demonstrated both experimentally and theoretically that this is not true in cases where such methods will really be advantageous—i.e., for structures where the atoms are for the most part not in special positions.

References

1. Lonsdale, K. *Nature*, **164**, 205 (1949).
2. ———. *Sci. Jr. Roy. Coll. Science*, **21**, 1 (1950).
3. Thewlis, J. *Ann. Repts. Progr. Chem. (Chem. Soc. Lond.)*, **47**, 420 (1950).
4. Pepinsky, R. In *Computing Methods and the Phase Problem in X-Ray Crystallography*. State College: Pennsylvania State College (1952).
5. van Reijen, L. In L. J. Bouman (Ed.), *Selected Topics in X-Ray Crystallography*. New York: Interscience, Part A, Chap. III (1951).
6. Wilson, A. J. C. *Nature*, **150**, 152 (1942); *Acta Cryst.*, **2**, 318 (1949); and later papers.
7. Frazer, B. C., and Pepinsky, R. *Phys. Rev.*, **85**, 479 (1952); *Acta Cryst.* (in press).
8. Levy, H., and Peterson, S. W., Jr. *J. Chem. Phys.*, **19**, 1416 (1951).
9. Bacon, G. E., and Thewlis, J. *Proc. Roy Soc. (London)*, **A196**, 50 (1949).
10. Bacon, G. E., and Lowde, R. D. *Acta Cryst.*, **1**, 303 (1948).
11. Karle, J., and Hauptman, H. *Ibid.*, **3**, 181 (1950).
12. Goedkoop, J. A. *Theoretical Aspects of X-Ray Crystallography*. Ph.D. thesis, Univ. Amsterdam (1952).
13. Nowacki, W. *Fouriersynthese von Kristallen*. Basel: Verlag Birkhäuser, 95–103 (1952).
14. Harker, D., and Kasper, J. *Acta Cryst.*, **1**, 70 (1948).
15. Shull, C. G., and Wollan, E. O. Unpublished data (1952).
16. Pepinsky, R., and MacGillavry, C. H. *Acta Cryst.*, **4**, 284 (1951).

Hugo Iltis: 1882–1952

L. C. Dunn

Department of Zoology, Columbia University, New York

Hugo Iltis, professor of biology at Mary Washington College of the University of Virginia, died at Fredericksburg, Virginia, on June 22, 1952. In the United States he was best known as the biographer of Mendel and the organizer of the Mendel Museum. In his native city of Brünn, Czechoslovakia, where he was born in 1882, he was known also as the professor of biology of the Deutsche Gymnasium (1905–38), *Privatdocent* of botany and genetics in the Deutsche Technische-Hochschule, and the founder and director of the Masaryk People's University (1921–38). To the German National Socialists and racists generally he was known as the declared enemy of the pseudo science on which Hitler's state was founded. His great energy and intensity of purpose enabled him to carry on simultaneously his activities as scientist, biographer, educator, organizer, and writer for the public. In fact, it was the mutual interdependence among these aspects of his life and character, a kind of synergistic interaction, which enabled a man who was not robust, and who was often in frail health, to accomplish so much in the two decades between the founding of the Czechoslovak state by Masaryk and its destruction by Hitler.

It was in this period that he published his *Gregor Johann Mendel: Leben, Werk und Wirkung* (Berlin: J. Springer [1924]; English ed., London: Allen & Unwin; New York: Norton [1932].) The first half of this work was a careful, appreciative account of Mendel's life based on the few original documents available, some of which Iltis himself rescued from oblivion at the Altbrünner Königinkloster. This is still the definitive biography of Mendel. The second half, an account of the development of Mendelism after the rediscovery of the principles in 1900, was of less permanent value and was not included in the English translation.

In the same year (1924) Iltis published his account of the founding of, and his program for, the Volkshochschule, an evening school for adult education that was unique for its time and place. He edited, from 1927 to 1938, the quarterly journal of this school, which bore the same title as Iltis' own bookplate, *Licht ins Volk*. One of the 1931 issues was a *Festschrift* celebrating the opening by this people's university of its own house, an effort for which Iltis had provided the moving spirit and raised most of the funds. The democratic purposes of this venture in popular education were explicit in its curriculum and activities; they were the outward manifestations of Iltis' own deeply felt political beliefs, as expressed in two pamphlets published in 1926: *Kampf um den Darwinismus* and *Naturwissenschaft und Sozialismus*. The second of these began: "The building-up of scientific knowledge is the essential foundation for the

development of the socialist society of the future." Iltis' devotion to the ideals of social democracy was based on his recognition of human need rather than upon doctrine. He would have found himself in close agreement with such founders of American democracy as Thomas Jefferson.

It was to be expected that Iltis, interested in science as a basis for democracy, and in genetics in particular, would oppose with all his strength the prostitution of science, and especially of genetics, by the German racists. He devoted most of the period from 1930 to 1938 to lecturing and writing on the race theories. He wrote three books, *Volkstümliche Rassenkunde* (1930), *Race in Science and Politics* (in Czech, 1935), and *Der Mythus von Blut und Rasse* (1935), containing Iltis' own introductory article, *"Der Rassismus im Mantel der Wissenschaft,"* and two other articles by him under pseudonyms. At this time, when the power of the Nazis was rising and spreading, Iltis made no attempt to conceal his views and stood in the forefront of the intellectual opposition. Since he was himself of German descent, of a family long resident in Brünn, where his father had been the town physician, he knew that he would earn the hatred of the Nazis, not only as a moral and intellectual enemy, but as a "racial traitor" as well. It was of course these activities that forced him to leave the town and the work he loved so well just before Hitler's troops arrived in 1939. At the age of 57 he began a new life in the United States.

After coming to this country his chief activities were in teaching at Mary Washington College, and especially in installing and building up the Mendel Museum there. The museum, an extension of one he had organized in Brünn, was based on some Mendeliana that Iltis had brought with him, with later additions illustrating some of the developments of modern genetics. In this, as in all his work, he was fortunate in having the collaboration of his wife, Anne Liebscher Iltis, who was first his student at the Volkshochschule in Brünn and later worked with him in building up the Mendel Museum, with which she now continues her connection.

Iltis' primary training was in botany, first in Brünn, later at Zürich as assistant to Dodel-Port, and then at Prague, where he took his doctorate under Molisch in 1903. His publications include, in addition to those on botanical subjects, others on natural history. He was the editor of *Flora Photographica* (Leipzig: Weigel), of which two volumes were published before the publishing house went out of business in 1933, and of *Studia Mendeliana* (Brünn, 1923).

In reviewing the life of a colleague and friend, one sees the essence of the scientific calling itself. On the table lie all the tangible remains of fifty years of hard and devoted work—the books, the bound volumes of scientific papers, the pamphlets, the unfinished manuscript of the book in progress. It is to this end that all must come. But one cannot judge the grist by the number of pages or the space occupied, because it is part of a larger whole that is maintained not merely by addition of facts and theories, but by the acquisition of a spirit in which courage, integrity, and devotion, like those of Hugo Iltis, are essential ingredients.

News and Notes

Harvey H. Bundy has been elected chairman of the Carnegie Endowment for International Peace to replace **John Foster Dulles.** Mr. Bundy has been a trustee since 1948 and vice-chairman since 1951. He was a special assistant Secretary of War from 1941 to 1945.

Kenneth E. Caster, University of Cincinnati geologist and paleontologist, has been elected a member of the Swedish and Norwegian geological societies. He is also a member of the French society and of the Brazilian Academy of Science. Dr. Caster is president of the Paleontological Research Institute.

Edward Sumner Elliott will become assistant plant pathologist at West Virginia University on Mar. 1. Dr. Elliott has been serving in a civilian capacity with the Army Chemical Corps at Camp Detrick.

Richard A. Kern, professor of medicine and head of the department at Temple University School of Medicine and head of the Medical Service at the University Hospital, has been named chairman of the Panel on Shipboard and Submarine Medicine of the RDB Committee on Medical Sciences.

Thomas B. Magath, chairman of the sections of Clinical Pathology and Biochemistry at the Mayo Clinic, has been made an honorary member of the medical faculty of the University of Chile, in recognition of his contributions to the field of parasitology.

John R. Richards has been named director of the Office of Research Service at New York University. The new office will coordinate, guide, develop, and promote research. Dr. Richards went to NYU from Washington, where he has been a special assistant for education to the Secretary of the Army.

Charles H. Riesz has been appointed to the staff of Armour Research Foundation of Illinois Institute of Technology to head project research in the area of catalysis, with particular reference to industrial applications.

Martin C. Sampson, instructor of medicine at the University of Pennsylvania School of Medicine and member of the Endocrine Section of University of Pennsylvania Hospital, has joined the Medical Staff of Smith, Kline & French Laboratories in Philadelphia. Dr. Sampson is on the staff of the Presbyterian Hospital, as well as the staff of the University of Pennsylvania Hospital.

George W. Schmitz has been appointed agronomist on the research staff of the Zonolite Company. Dr. Schmitz will conduct research in agricultural applications of vermiculite.

Emil Schwarz, of the Department of Hematology, Medical Research Institute, Michael Reese Hospital, has been made an honorary fellow of the International Hematological Society.

Emilio Segre, professor of physics at the University of California, Berkeley, has been awarded the Hoffmann Medal by the German Chemical Society. Given for the first time since before World War II, the medal is one of the high honors of German science. **Roger Adams,** organic chemist of the University of Illinois, and former AAAS president, also received a medal this year.

The Association of American Colleges has announced the retirement next June of its executive director, **Guy E. Snavely,** 71. The association appointed a committee of college presidents to find a successor. Dr. Snavely plans to remain a consultant in the field of higher education.

Russell L. Sylvester has been appointed manager of engineering and chief engineer of the Equipment Division of National Research Corporation. Mr. Sylvester has been with National Research since February. He was formerly the owner and manager of the Rollins Engine Co., of Nashua, N. H.

Denis R. A. Wharton, formerly of the Institute for Cancer Research at Fox Chase, Pa., has joined the Pioneering Research Laboratories of the U. S. Army Quartermaster Depot in Philadelphia.

Richard H. Wilhelm, professor of chemical engineering, Princeton University, has received the 1952 Professional Progress Award in Chemical Engineering, sponsored by Celanese Corporation of America and administered by the American Institute of Chemical Engineers. Dr. Wilhelm was cited "for his distinguished contributions to the theories and experimental data of fluid mechanics, mass and heat transfer, and reaction rates, and for his special applications of these theories to fluidized solid systems and to biochemical and textile processing."

Abner Wolf, professor of neuropathology at Columbia University College of Physicians and Surgeons, was presented with the annual United Cerebral Palsy–Max Weinstein Award for "outstanding scientific achievement" in the field of cerebral palsy at the third annual convention of United Cerebral Palsy.

Education

Marquette University will establish a Kurtis R. Froedtert professorship in the Department of Surgery of the Medical School with a gift of $10,000 from the Kurtis R. Froedtert Memorial Trust.

New York University's Division of General Education will present a series of lectures entitled "The Impact of Science on Contemporary Thought" during the spring term. Guest lecturers will speak on Monday evenings, Feb. 2 through May 25. The speakers will be Philipp G. Frank, who will be in charge of the program (two lectures), P. W. Bridgman, E. C. Kemble, I. A. Richards, K. W. Deutsch (two lectures), Herbert Feigl, R. K. Merton, Ernest Nagel, C. G. Hempel, John Clark, and Richard von Mises.

Northwestern University has granted leaves of absence to the following: Kenneth E. Olson, for the winter quarter, to accept a State Department appointment to set up a program of education for journalism in Greece and to complete research on the Greek and Italian press; Melville J. Herskovitz, for six months beginning Jan. 1, to do research in anthropology in Africa under a Fulbright award; Paul K. Hatt, Helmer R. Myklebust, and Frederick R. Schmidt, to do research; George H. Mickey, for the spring quarter, to act as a consultant at Oak Ridge National Laboratory; Paul E. Klopsteg, for the academic year, to continue with the National Science Foundation as assistant director.

Oak Ridge School of Reactor Technology will begin its 1953–54 session in September. Applications for admission must be submitted not later than *Mar. 1.* The school is open to recent graduates and to sponsored students from industry and from government agencies.

Grants and Fellowships

The **Health Information Foundation** has appropriated $275,000 for research "to determine the coverage and effectiveness of voluntary health insurance plans and indicate areas where extension of coverage and benefit provisions are required." The National Opinion Research Center, of the University of Chicago, under the direction of Clyde W. Hart, will conduct two studies in the program; a third study, which may continue through 1955, will require additional financing; the fourth study, which will seek data on family debts and their relationship to illness and medical costs, will be undertaken by HIF's own research staff, headed by Odin W. Anderson, and in consultation with Dr. Hart.

The **National Research Council of Canada** will award about 200 postgraduate scholarships for study in science and engineering during 1953–54. Most of the awards are tenable in Canadian universities, but there are some special scholarships, at $1500 for 12 months, tenable outside Canada, and postdoctorate overseas

fellowships, at $2500. Applications should be addressed to the council's Awards Officer, Ottawa.

The **Office of Naval Research** Physiological Psychology Branch has recently initiated new research projects at the School of Medicine, Washington University, where George H. Bishop is investigating the mechanisms of cortical activity in terms of action currents; and at Ohio State University, where Glenn A. Fry is investigating the effect upon normal color vision produced by the adaptation of the eye to selected wavelengths within the visual spectrum at various levels of stimuli intensity. ONR has also extended 14 projects already in progress.

Sharp & Dohme have awarded a one-year grant to the Utah Agricultural Experiment Station for the work of D. M. Hammond and M. L. Miner. Grants were also made to the Donner Laboratory of McGill University and the Royal Victoria Hospital, Montreal, in support of the work of Richard D. McKenna; and to Evans Memorial Hospital, Boston, for investigations by F. J. Ingelfinger and by Francis C. Lowell. The following renewals have been announced: Johns Hopkins University, for research by Bacon F. Chow; University of Wisconsin, for Elva S. and Roland K. Meyer; Western Reserve University, for L. O. Kramptiz; and University of Pennsylvania, for Marvin Carmack.

The **Wool Bureau,** on behalf of its affiliate, International Wool Secretariat, representing wool growers of the British Dominions, has renewed its support of the wool research program at the Textile Research Institute, Princeton, N. J.

Meetings and Elections

The New Jersey Section of the **American Institute of Chemical Engineers** will hold its annual All Day Symposium May 5 at the Essex House, Newark. "Centrifuging" and "Catalysis" will be discussed at two symposia, and there will be a series of three papers on "Project Evaluation in the Chemical Industry."

At its annual meeting the **American Public Health Association** named Wilton L. Halverson, of San Francisco, president, and Hugh R. Leavell, of Harvard, president-elect. Kenneth F. Maxcy, of the Johns Hopkins University School of Hygiene and Public Health, received the 1952 Sedgwick Memorial Medal "for distinguished service in public health."

The **American Society for the Study of Arteriosclerosis** has elected the following officers: president, Nelson W. Barker; vice president, Russel L. Holman; secretary-treasurer, O. J. Pollak. The next annual meeting will be held Nov. 1–2, at the Hotel Knickerbocker, Chicago. Louis N. Katz, Michael Reese Hospital, Chicago 16, is program chairman; deadline for abstracts is *May 30*.

Officers for 1953 of the **American Society of Zoologists** are: president, E. Newton Harvey, of Princeton; vice president, Libbie H. Hyman, of the American Museum of Natural History; secretary, S. Meryl Rose, of the University of Illinois; treasurer, Harry A. Charipper, of Washington Square College. The next meeting of the society will be held with Section F of the AAAS in Boston, December 1953.

The **Association of American Medical Colleges,** meeting in Colorado Springs, installed Ward Darley as president, and named Stanley Dorst president-elect. John Z. Bowers is the new vice president, and Dean F. Smiley and John B. Youmans are secretary and treasurer, respectively. The Borden Award in Medical Sciences was presented to William S. Tillett for his work in isolating streptokinase and streptodornase.

New officers of the **Association of Consulting Chemists and Chemical Engineers, Inc.,** are: president, Foster Dee Snell; vice president, A. Taub; secretary, Thomas P. Kearney; and treasurer, Percy E. Landolt.

The **Congreso Panamericano de la Prensa Médica** will meet in Buenos Aires July 12–16. At the same time there will be a **Semana de Alta Cultura Médica Europea** at the Facultad de Ciencias Medicas de Buenos Aires. Roque A. Izzo, Morris Fishbein, and Fred Soper are the congress vice presidents, and the headquarters are in the Biblioteca de Facultad de Medicina de Buenos Aires, Calle Uriburu 763.

The first **International Congress on Medical Librarianship** will be held in London during the week of July 20. Cecil Wakeley, president of the Royal College of Surgeons, has accepted the honorary chairmanship of the congress, and a number of honorary vice presidents have been appointed. Further information may be obtained from W. J. Bishop, Wellcome Historical Library, London, or L. Margueriete Prime, American College of Surgeons, 40 E. Erie St., Chicago 11.

The **Southern Association of Science and Industry** will hold a regional conference Apr. 20–21 in New Orleans. The program will focus attention on economic, technical, and social aspects of the problems of air and stream pollution. Harold R. Murdock, of Atlanta, is chairman of the planning committee.

A **Symposium on the Optical Problems of Vision** will be held at the Institute of Optics in Madrid Apr. 15–17. This program is sponsored by the International Union of Pure and Applied Physics, and is being planned by the Spanish National Committee of that union. It is timed so as to be part of the celebration of the 50th anniversary of the founding of the Royal Spanish Society of Physics and Chemistry. Chairman of the symposium will be J. A. Artigas, and the secretary will be J. M. Otero, director of the Institute of Optics. Invited papers will be presented by Drs. Granit, of Sweden; Le Grand, of France; Stiles, of England; and Wald of the U. S. Following the sym-

posium, the third regular congress of the International Commission of Optics will be held, also in Madrid. Further information on these meetings may be obtained from the chairman of the U. S. A. National Committee of the International Commission of Optics, Stanley S. Ballard, Tufts College, Medford 55, Mass.

Miscellaneous

The **AAAS-George Westinghouse Science Writing Awards** of $1000 each were presented to Alton L. Blakeslee, science editor for the Associated Press, and Morton M. Hunt, free-lance writer, at the Annual Meeting of the AAAS in St. Louis. Mr. Blakeslee's award was given for a series of four stories entitled "Visit to a Laboratory," published in Associated Press member-newspapers, and Mr. Hunt's was given for his article "Neurosis Factory," which appeared in *Esquire*. Honorable Mention citations were awarded to Milton and Margaret Silverman, for their article "So That's What Happens to Child Prodigies!" which appeared in the *Saturday Evening Post*, and to Charles A. Federer, Jr., for his story "Moon Films Aid Navigation Study of Atmosphere's Light Rays Effect," published in the New York *Times*.

The **American Society of Mechanical Engineers** made the following awards at its annual banquet: Daniel Guggenheim Medal, Geoffrey de Havilland; Alfred Noble Prize, Myron Tribus; ASME Medal, Nevin E. Funk; Holley Medal, Sanford L. Cluett; Worcester Reed Warner Medal, Max Jacob; Melville Medal, Neil P. Bailey; Junior Award, Warren M. Rohsenow; Richards Award, Jesse H. Davis; Pi Tau Sigma Gold Medal Award, Hubbert L. O'Brien.

Recent visitors at the **Eastern Regional Research Laboratory,** ARA, Philadelphia, were Odd Tvette, Ministry of Agriculture, Norway; K. E. Murray, Research Office, Scientific and Industrial Research Organization, Australia; and R. G. Tompkins, Ditton Laboratory, East Malling, England.

The **Sidney Hillman Foundation** prizes for newspaper and magazine reporting were awarded to Carl T. Rowan, of the Minneapolis *Tribune* for a series of articles dealing with race relations in the South, and to Arthur D. Morse, free-lance writer, for an article in *McCall's* entitled "Who is Trying to Ruin our Schools?" The prize for nonfiction was awarded to Alan Barth, of the Washington *Post*, for his book, *The Loyalty of Free Men*.

The **International Council of Scientific Unions** has set up an Abstracting Board for the purpose of facilitating the work of existing well-established journals publishing abstracts of original papers in the field of the natural sciences. Verner W. Clapp is chairman of the board, which is composed of Elmer Hutchisson, representing IUPAP; J. H. Awbery, representing *Science Abstracts*; G. Kersaint, representing *Bulletin Analytique*; A. V. Hill, secretary-general of ICSU; and G. A. Boutry, *secretary*. L. H. Lampitt sits as an observor for the International Union of Pure and Applied Chemistry. Offices are at the Institut d'Optique, 3, Blvd. Pasteur, Paris, 15°, where work has already begun.

The new physics and engineering laboratories, which were recently opened by Frederick A. Lindemann at **King's College, University of London,** were constructed completely underground. Teaching and laboratory facilities have been provided in the two-story structure built between ground level and water table, and the old engineering building is being used as a laboratory for concrete technology. The Wheatstone Laboratory at King's College traces its beginnings back to 1831, although it was not until 1834 that Charles Wheatstone was appointed professor of experimental philosophy. Today, in addition to instruction and research in all phases of engineering and experimental physics, the laboratory sponsors an ambitious program in biophysics.

Recent visitors at the **National Bureau of Standards** included B. Ramamurti, Central Statistical Organization, India; Ferdinand Trendelenburg, Siemens-Schuckert Co., Erlangen, Germany; L. Escande, University of Toulouse; Yoshio Yamamoto, Isugami Mfg. Co., Tokyo; Patrick J. Rodgers, Overseas Communication Society, India; Hans Dreyer, Technicalische Hochschule, Darmstadt; Ole Soested, Danish Dental Association; N. W. Crisp, International Bank of Reconstruction and Development, and S. L. Bengtson, International Construction Company, London.

In memory of Guido Fubini, **l'Unione Matematica Italiana** will award an international prize in mathematics for important contributions in the field of differential geometry published between Jan. 1, 1946, and Dec. 31, 1953. Applicants should submit lists of such works to the president of the union before *Mar. 31, 1954,* but the awarding committee may also consider works published within the period by mathematicians who do not so apply. If there should be no suitable works in differential geometry, the committee may also grant the prize for contributions made in the same period to the theory of automorphic functions and related topics. The committee consists of Salomon Bochner, Princeton University; Charles Ehresmann, University of Strasbourg; and Alessandro Terracini, University of Turin.

In its 1952 Frontiers in Chemistry lecture program, **Western Reserve University** will present the following speakers in discussions of "Advances in Colloid Chemistry": Bruno H. Zimm, Feb. 27; Maurice Morton, Mar. 13; Samuel H. Maron, Mar. 27; Harry P. Gregor, Apr. 10; and Victor K. La Mer, Apr. 24. In the series on "Theoretical Organic Chemistry," the following will speak: George E. Kimball, Mar. 6; Peter E. Yankwich, Mar. 20; Charles Gardner Swain, Apr. 13; Robert B. Mesrobian, Apr. 17; and Henry Eyring, May 1.

Technical Papers

The Disposition of Intraperitoneally Injected Foreign Matter in Amphibia

Thomas W. Easton
207 Whitmoor Terrace, Silver Spring, Maryland

An attempt has been made to compare the behavior of macrophages in various amphibia with similar behavior in mammals, using Thorotrast[1] as an injection material. The author (*1*) has previously reported that mice injected with Thorotrast dispose of the substance via the urine and bile in the colloidal state, and via the lungs in macrophages. In the latter instance, the macrophages are either cast out of the mouth with mucus and saliva or are swallowed, to leave the body in the feces. Irwin (*2*) also indicated that in the mammal the lungs function in removal of such macrophages.

Although it has not been possible to make quantitative measurements of movements of ThO_2 in the amphibian body, histological observations have yielded considerable information on the means by which amphibia lose injected foreign matter (Table 1). The number of amphibian forms readily available has imposed a further limit upon this study.

Specimens were killed by decapitation. Pieces of liver, spleen, lung and/or gill, kidney, stomach, upper intestine, muscle with skin, and gonad were fixed in Bouin's fluid, embedded in paraffin, and sectioned at 5 μ. All tissues were stained with Delafield's hematoxylin and eosin.

The specimens used offer a variety of conditions for comparison with the mammal. *Ambystoma* and the adult *Rana* spp. possess lungs; *Desmognathus* have neither lungs nor gills; the larval *R. catesbiana* have both lungs and gills; and the *Eurycea* and *Pseudotriton* larvae have gills only.

Adult Anura: In the frogs, the *R. palustris* killed 3 days post-injection still had large numbers of thorium-filled macrophages in the abdominal cavity. The two *R. sylvatica*, killed at 5 and 10 days, had none. In other respects, except for the skin, the three specimens agree.

In the liver, heavily charged Kupffer cells were numerous, and were widely scattered without regional concentration. Loaded macrophages were common in the lumina of both portal and hepatic veins. There were granules of ThO_2 in liver parenchymal cells, concentrated usually adjacent to the bile canaliculi. There were also free granules of ThO_2 in the bile ducts and gall bladder.

The three spleens contained large quantities of ThO_2. Here nearly all the ThO_2 was located in macrophages packed into or around well-defined sinuses. In the lungs, filled macrophages were located in capillaries and in the tissues outside of capillaries, but adjacent to them. They were also lying free in the air passages or in flakes of mucus on the surface of the lung epithelium. In the kidneys, many glomerular capillaries, the lumina of some of the tubules, and a few capsular spaces contained macrophages with ThO_2. In addition, in the *R. sylvatica* female (10-day specimen), the cells of some of the proximal convoluted segments contained spherical bodies having the appearance of ThO_2, about midway between the base and apex of the individual cell.

The stomach and gut of all three specimens also exhibited macrophages filled with ThO_2, both fixed in the tissues of the walls and free in the lumina. In one (10-day *R. sylvatica*), small macrophages containing ThO_2 appeared to be passing through the epithelium of the gut into the lumen.

Only the *R. palustris* (3-day) had charged macrophages in or immediately beneath the skin. This specimen had a few small macrophages with moderate quantities of ThO_2 passing through the epithelium of the skin glands into their lumina. These macrophages were not numerous and certainly do not indicate that the skin is a major route of ThO_2 removal.

Adult Urodela: The five *A. maculatum* gave a picture similar to, but differing consistently from, that of the frogs. All five had some filled macrophages in

TABLE 1

SPECIMENS, DOSAGES, AND KILLING TIMES

Species	Sex	No.	Dosage (ml) undiluted Thorotrast	Killed (No. days after injection)
Adult forms				
Anura				
Rana palustris	Male	1	0.1	3
R. sylvatica	"	1	.2	5
" "	Female	1	.2	10
Urodela				
Ambystoma maculatum	Male	5	.3	One on each of days 1, 3, 5, 10, and 15
Desmognathus f. fusca	"	1	.2	7
Larval forms				
Anura				
R. catesbiana	?	1	.1	2
Urodela				
Eurycea bislineata	Male	1	.05	5
E. bislineata	Female	1	.05	5
Pseudotriton r. ruber	?	1	0.2	5

[1] Thorotrast is a colloidal preparation of ThO_2 in aqueous medium approximately 25% ThO_2 by weight, made by Heyden Chemical Corp., New York. The preparation is stabilized by addition of approximately 20% by weight dextrin.

the abdominal cavity. In all, Kupffer cells throughout the liver contained large amounts of ThO_2. With the exception of the 15-day specimen, there were free loaded macrophages in all vessels of the liver, and some granules of ThO_2 in parenchymal cells. The spleen had, in every case, considerable numbers of ThO_2-charged macrophages located within distinct sinuses. The lungs contained cells with ThO_2 in capillaries, in the tissues outside the capillaries, free in the air passages, and free in the lumina of larger blood vessels. The kidneys had the same appearance as those of the frogs described above.

The stomach and gut differed from those of the frogs in showing very few loaded macrophages in the lumen or in the wall, and in having no appearance whatever of discharge of ThO_2 through the epithelium. The same was observed in relation to the external skin. There was no sign of passage of ThO_2 into the lumina of the glands, and very little ThO_2 in subcutaneous macrophages. The epithelium of the cloaca, however, although without ThO_2 in or beneath the surface layer, was thickly covered with mucus containing vast numbers of heavily loaded macrophages, as well as fragments of such cells and free granules of ThO_2. The cloaca of the frogs was not studied.

In the one *Desmognathus* (lacking both lungs and gills), ThO_2 was distributed in exactly the same manner as in the adult *Ambystoma,* except, of course, for the lung. Otherwise, the difference between the two was strictly one of degree. The kidney and cloaca had much heavier and denser amounts of ThO_2 in *Desmognathus.*

Larval forms: These in general agree with the adults in the distribution of ThO_2 observed. The liver could not be distinguished from that of adults on the basis of thorium distribution. The larval spleens contained some large masses of Thorotrast granules free in sinuses, along with larger quantities in macrophages. The gut contained some ThO_2 in macrophages in the walls and lumen, but none of the larvae gave evidence of transfer of Thorotrast through the epithelium.

The kidneys differed slightly from those of adults in showing as a constant feature granules of material that seemed to be ThO_2 within cells of the proximal convoluted segments of the tubules, apparently being discharged. Larval skin had the appearance of adult skin. The *R. catesbiana* larva had both gills and lungs, but the larval urodeles had gills only. The *Rana* lung had not yet begun to function in respiration. In all four larvae, the gills were observed to contain filled macrophages in capillaries, in the tissues outside the capillaries, and on the external surface of the gill epithelium, either sticking directly to the latter or trapped on it in attached flakes of mucus. The lungs of the *R. catesbiana* tadpole contained ThO_2 in macrophages in capillaries and in the tissues outside the capillaries, but none in the lumen of the lung.

In no specimen studied was there any significant amount of ThO_2 in skeletal muscle. Isolated macrophages located between muscle fibers contained a few granules only.

The presence of ThO_2-filled macrophages in both portal and hepatic veins suggests, as more comprehensive data have done for the mammal, that filled macrophages move through the liver, presumably largely from the spleen.

The amphibian lung and gill observations further suggest that whichever of these is active in respiration is also responsible for the release of a part at least of the ThO_2 introduced into the body.

Furthermore, the presence of granules of ThO_2 free and in macrophages in various parts of the kidney—i.e., glomeruli, lumina of tubules, cells of the proximal convoluted segment, and also in the cloaca—suggests that the kidney is at all times active in the removal of circulating Thorotrast. The one *Desmognathus,* lacking both lungs and gills, showed a much higher degree of saturation in the kidney than other specimens and much more ThO_2 in the cloaca. This indicates that in the absence of lungs and gills the kidney is the chief organ of disposal of ThO_2. This is in contrast to the situation in mammals, in which the kidney removes a very small part of any ThO_2 injected, and the lung, absent in *Desmognathus,* is the chief organ of Thorotrast removal.

That the skin, which serves also for respiration, may serve as an organ for disposal of macrophages carrying ThO_2 is suggested by the finding of such cells in the lumina of skin glands in one of the frogs. However, the rarity of the observation (one frog, no urodeles) indicates that this route is not an important one.

Further investigation of this problem in a more quantitative manner would be highly desirable for comparison with the situation in mammals.

References

1. Easton, T. W. *Am. J. Anat.,* **90**, 1 (1952).
2. Irwin, D. A. *Can. Med. Asso. J.,* **27**, 130 (1932).

Manuscript received June 23, 1952.

Radioactivity Induced in Yeast by 100 Mev X-Radiation[1]

G. C. Baldwin and Leonard B. Clark

Research Laboratory, The Knolls, General Electric Company and Biology Department, Union College, Schenectady, New York

Mayneord, Martin, and Layne (*1*) have shown that 24 mev of x-radiation induces a small amount of radioactivity in tissue, ascribed to production of O^{15} and C^{11} by (γ,n) reactions.

In view of the fact that Mayneord *et al.* were working near the thresholds of these reactions, and that maximum yields are expected at much higher voltages

[1] Work carried out under contract with the Office of Naval Research, with the support of the Atomic Energy Commission and the General Electric Research Laboratory.

(*2*), it was deemed desirable to extend this study to 100 mev, well above all known threshold and resonance levels.

Computations based on analysis of yeast and on physical data for cross sections (*3*), resonance energies (*2*), and x-ray spectrum indicated that the dose rate in this material that is due to radioactivity would be of the order of $2 \times 10^{-5} \times$ the dose rate that is due to direct absorption of the x-radiation.

Blocks of yeast were irradiated with x-rays from the 100 mev betatron. Samples were counted by means of a special device built by one of us (G.C.B.) for the study of short-lived activities, with which counting could begin 0.2 sec after a precisely timed irradiation. The findings were:

1. No short-lived activities of $0.5 < T < 125$ sec are induced.
2. The resulting activity is due to O^{15}, C^{11}, and N^{13}. Their initial proportions, 1.00, 0.013, and 0.16, are in agreement with the above computations for the counting geometry employed.
3. Type K film placed in the yeast recorded less than 0.005 r after an irradiation to a total dose of 3050 r, the film exposure being such as to collect 60% of the total delayed dose. This is obviously a negligible fraction of the original dose.

References

1. Maynebord, W. V., Martin, J. H., and Layne, D. A. *Nature*, **164**, 728 (1949).
2. Baldwin, G. C., and Klaiber, G. S. *Phys. Rev.*, **73**, 1156 (1948).
3. Friedlander, G., and Perlman, M. L. *Ibid.*, **74**, 442 (1948); Lawson, J. L., and Perlman, M. L. *Ibid.*, 1190.

Manuscript received June 19, 1952.

Developmental Forms of Vaccinia Virus[1,2]

William H. Gaylord, Jr., and Joseph L. Melnick

Section of Preventive Medicine and
Department of Microbiology,
Yale University School of Medicine,
New Haven, Connecticut

The mode of vaccinia virus reproduction is unknown. Wyckoff (*1*) has described certain bodies in vaccinia-infected cells, thought to be associated with virus production, which were in the size range of, but less opaque than, elementary bodies (mature, infective virus particles). Gaylord, Melnick, and Bunting (*2*) recently pointed out that vaccinia elementary bodies appear as discrete particles only in large, and presumably old, inclusions, whereas elementary bodies in small inclusions were obscured by a dense matrix. The observations here correlate these findings and extend them to show a relationship between the less opaque bodies and mature virus.

Thin sections of chick chorio-allantoic membrane infected with vaccinia were prepared for electron microscopy, according to the method of Palade (*3*), using osmium tetroxide buffered at pH 7.3, with veronal-acetate for fixation. One drop (0.05 ml) of virus suspension was inoculated on the membrane of 15-day eggs and harvested after 72 hr. Nonspecific lesions, caused by introducing a like amount of an isotonic salt solution on 15-day membranes, were excised after 72 hr and used for controls. The tissues were imbedded in methacrylate, which was not removed from sections except for comparison studies. Some sections were flattened by floating on warm (60° C) water; others were suitable for observation immediately.

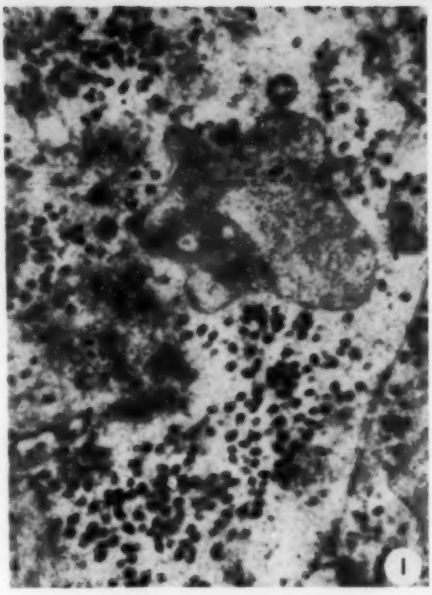
The ectoderm of 72 hr membranes was heavily infected from the surface to the basal layer, but no virus was seen in the mesoderm or entoderm. Mitochondria were numerous in both infected and control cells, occurring as rounded, swollen forms in the ectoderm, as long filaments in the fibroblasts of the mesoderm, and as short, thick filaments, often fragmenting, in the entoderm. They were easily distinguished from mature virus because of their larger size, irregular shape, and low electron density. Elementary bodies appeared as dense, uniform, discrete particles in great numbers throughout most of the cytoplasm. In very thin sections the hollow interior of the thick-walled mature virus particle previously described (*2*) was readily visible.

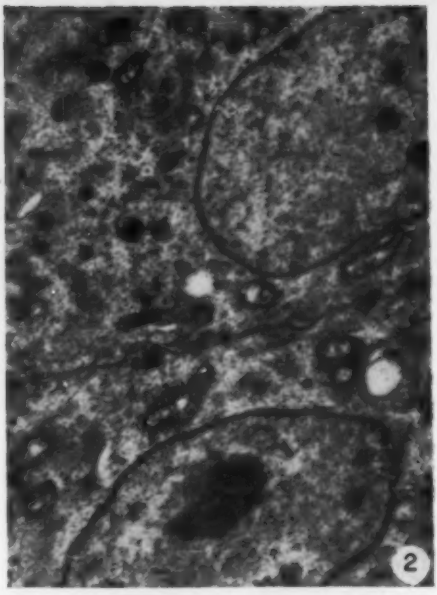
The cytoplasm in the central perinuclear region of many infected cells was more dense than normal (Fig. 1). Such areas were usually well demarcated and are considered to be the matrix observed in formalin-fixed sections (*2*). Within these areas round or oval-shaped bodies were seen (Figs. 3, 4) that had the dimensions of mature virus or were slightly larger in diameter. The bodies were always less dense than mature virus and presented a variety of internal structures. Some appeared to be empty circles bounded by a delicate membrane (Fig. 6); in others a small dot of dense material appeared (Figs. 3–6, 8). The dense inner body was present in sizes ranging from the barely visible to a diameter approaching that of mature virus and was located either centrally or eccentrically. At other times the whole body was filled with material of low electron density (Fig. 7). In such cases the limiting membrane was still visible. Many of the bodies were half or only partially filled with the low density material, and in these forms the denser small mass could sometimes be seen (Fig. 8). At times, when the internal body approached the size of an elementary body, it was also "empty," giving the appearance of concentric circles (Fig. 3).

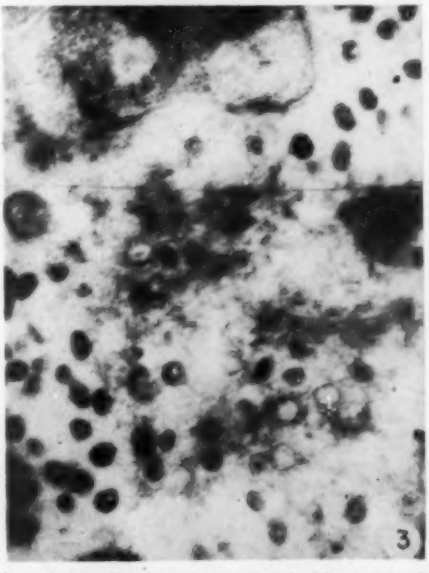
All the above-described bodies are considered by us to be virus developmental forms in different stages of maturation. They were regularly seen in infected cells and never in control cells. They occurred most frequently in the perinuclear matrix area of a cell, and less frequently in areas where mature virus was highly concentrated. Their size was of the order of magnitude of mature virus, being somewhat larger. Mature virus was oval-shaped, with major axes of 200–

[1] Aided by grants from the Fluid Research and James Hudson Brown Memorial Fund of Yale University School of Medicine.

[2] The data for this paper form part of a dissertation to be presented by William H. Gaylord, Jr., in partial fulfillment of the requirements for the Ph.D. degree, Yale University.







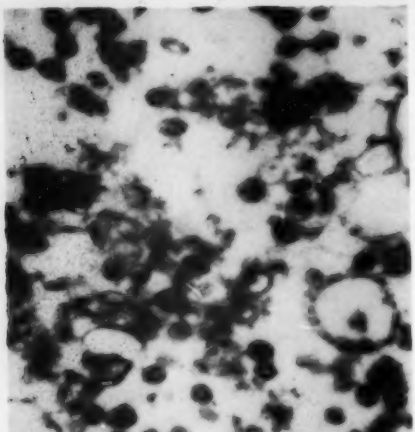
FIGS. 1–4. 1—Ectodermal cell infected with vaccinia virus. Area at lower left of nucleus is matrix within which "developmental" forms predominate. Mature virus appears as black particles. × 8000.

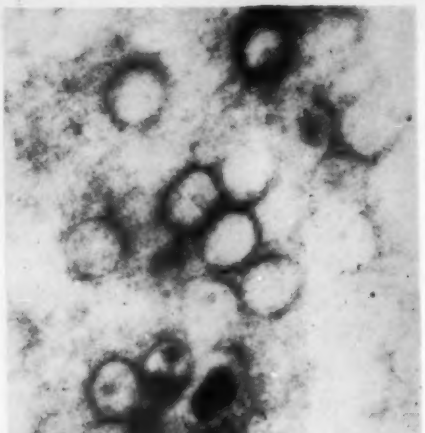
2—Portions of two control cells. × 8000.

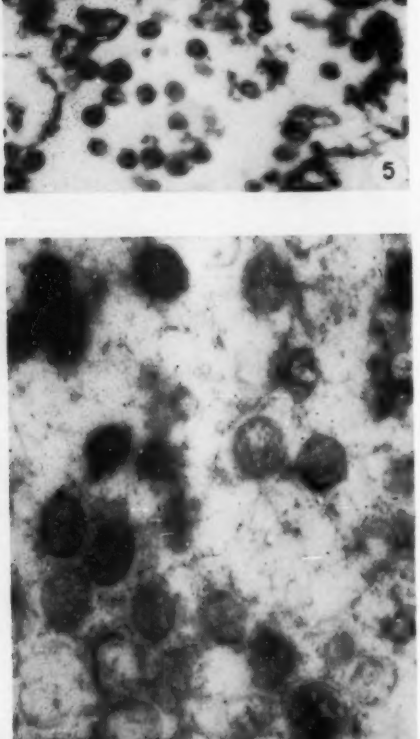
3—Matrix area from cell in Fig. 1 taken at greater magnification. Close examination, especially of original plates, reveals more than 25 virus developmental bodies imbedded in matrix. × 18,000.

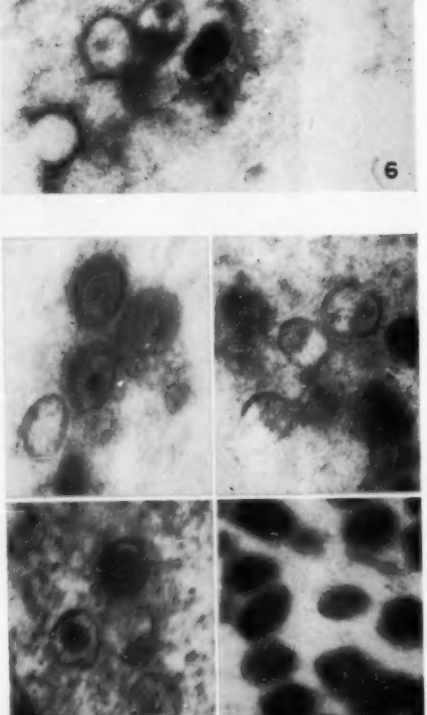
4—Matrix area of a cell from which methacrylate had been removed. Many stages of developmental bodies can be seen. Negative print, palladium-shadowed. × 11,000.

250 mμ and minor axes of 110–150 mμ. The less opaque bodies were usually circular, with diameters of 250–290 mμ. Oval shapes attained long axes of 400 mμ. They presented a remarkable degree of uni-









FIGS. 5–8. 5—Area showing developmental bodies in different stages, as well as mature virus particles. The latter have greater electron density and "hollow" interiors. × 16,000.

6—Higher magnification of virus developmental bodies, showing a predominance of "hollow" forms. × 37,500.

7—Developmental bodies, several filled with homogeneous material of low electron density. × 42,000.

8—Virus developmental bodies in different stages of growth. Upper left, body filled with homogeneous, low-density material, one of which has a denser internal structure. Upper right, partially filled bodies. Lower left, larger internal structures, presumably a more advanced stage of development. Lower right, mature virus particles from another area of the same cell. All × 40,000.

formity, unlike mitochondria or other normal cellular constituents or of the cross-sectioned endoplasmic reticulum described by Palade (*3*).

It would appear that each "developmental body" gives rise to a single mature virus particle (classical elementary body). The smaller internal mass seems to

develop in size, at the expense of the less dense material (Fig. 8), to emerge as a mature particle. The picture of mature virus forming from larger, less dense bodies imbedded in a matrix material is similar to the situation described by Banfield, Bunting, Strauss, and Melnick (*4*) for molluscum contagiosum. In retrospect, some of their micrographs may be reinterpreted in the light of the present findings. Close re-examination of their original plates (*4*) reveals that in molluscum contagiosum the "holes" in the cytoplasmic matrix contain dense bodies ranging from the barely visible to the size of mature virus particles, with the entire "virus developmental" body seemingly encased in a fine membrane. We have also observed similar developmental forms (precursors of mature virus) in cells infected with ectromelia virus, another member of the pox group.

References

1. Wyckoff, R. W. G. *Proc. Natl. Acad. Sci., U. S.*, **37**, 565 (1951).
2. Gaylord, W. H., Jr., Melnick, J. L., and Bunting, H. *Proc. Soc. Exptl. Biol. Med.*, **80**, 24 (1952).
3. Palade, G. E. *J. Exptl. Med.*, **95**, 285 (1952).
4. Banfield, W. G., *et al. Proc. Soc. Exptl. Biol. Med.*, **77**, 843 (1952).

Manuscript received June 18, 1952.

Crown Gall Suppression by Anti-Auxin[1]

Paul E. Waggoner and A. E. Dimond

The Connecticut Agricultural Experiment Station, New Haven

The continued depression of auxin level in plants, following exposure to ionizing radiation (*1*), has been suggested (*2*) as a mechanism by which radiation suppresses crown gall caused by *Agrobacterium tumefaciens*. If this suggestion is correct, then other agents that lead to auxin destruction should suppress galls.

This prediction was tested by exposing carrot roots inoculated with *A. tumefaciens* (*3*) to maleic hydrazide (MH), an agent that increases enzymatic destruction of indolacetic acid (IAA) (*4*). A carrot root was surface-sterilized, cut transversely into 12 slices ½ cm thick, and a slice placed apical-end down on 2% water agar in each of 12 Petri plates. Similar slices from 3 other roots were also placed in each plate. The surfaces of all slices were inoculated at the same time with an aqueous suspension of *A. tumefaciens* (Riker's strain A-6). The 4 slices in a plate were transferred at the times shown in Table 1 to another plate, where the agar solution contained a 2.67×10^{-3} *M* concentration of the diethanolamine salt of MH.[2] After incubation at room temperature for 12 days, the galls on the slices from each root were ranked according to size (Table 1).

Evidently crown gall development is suppressed by MH applied as late as 168 hr after inoculation. Similar results were obtained in experiments using plants growing in the greenhouse. When the roots of tomato plants were dipped in 5.24×10^{-3} *M* solution of MH salt 8 days after, or at the time of, inoculation, only small galls developed, whereas large galls developed on untreated plants.

TABLE 1

Rank of Gall Sizes on Carrot Root Slices Transferred to a 2.67×10^{-3} *M* Solution of Diethanolamine Salt of MH

Transfer, hr before (−) or after (+) inoculation	Root			
	1	2	3	4
−168, −120, −24				
0, +4, +8	0*	0	0	0
+ 24	0	0	4	0
+ 96	1†	2	1	0
+168	2	1	2	0
No. MH	3, 4‡	3, 4, 5	3, 5, 6	1, 2, 3

* No gall.
† Smallest gall on root 1.
‡ Contaminated.

The effect of MH upon multiplication of the pathogen was determined by growing it in a 2% glucose and 0.2% yeast extract medium containing concentrations of the MH salt up to 28.8×10^{-3} *M*. No relation between turbidity and MH concentration was evident after 24 hr at room temperature.

These experiments show that MH, which is known to increase enzymatic destruction of IAA (*4*), suppresses gall formation by affecting tumor enlargement, not by affecting alteration of normal to tumor cells or by affecting pathogen multiplication. In these respects MH suppresses galls in the same way as does ionizing radiation. The hypothesis that radiation suppresses galls by depressing the auxin level has thus led to a prediction borne out by experimentation. Whether the hypothesis accounts for the entire radiation effect remains to be seen.

References

1. Skoog, F. *J. Cellular Comp. Physiol.*, **7**, 227 (1935).
2. Waggoner, P. E., and Dimond, A. E. *Am. J. Botany* (in press).
3. De Ropp, R. S. *Ibid.*, **37**, 352 (1950).
4. Andreae, W. A. Mimeo. Abst., Am. Soc. Plant Physiol. Meeting, Ithaca, N. Y. (1952).

[1] Research conducted under contract AT(30-1)-580 with the Atomic Energy Commission.

[2] The MH was supplied by the Naugatuck Chemical Division, U. S. Rubber Company.

The Effect of Triphenyltetrazolium Chloride on Oat Embryo Respiration[1]

Glyn O. Throneberry and Frederick G. Smith

Department of Botany and Plant Pathology, Iowa State College, Ames

The reduction of tetrazolium salts has been widely

[1] Journal Paper No. J-2115 of the Iowa Agricultural Experiment Station, Ames. Project 1083. This study was made in part under authority of the Agricultural Marketing Act of 1946 (RMA, Title II) and was carried out in cooperation with the Grain Branch, Production and Marketing Administration, U. S. Department of Agriculture.

used as an indicator of viability and as a measure of metabolic activity in tissues and tissue extracts (*1*). Pyridine nucleotide–linked dehydrogenases (*2, 3*) mediated by diaphorase (*3, 4*), succinic dehydrogenase (*5, 6*), xanthine oxidase (*3*), and cysteine desulfurase (*7*) (by H_2S production) are known to catalyze this reduction *in vitro*. The reaction has been found to be more rapid in the absence of oxygen with liver homogenates (*4, 7*), microorganisms (*8, 9*), and a reduced cozymase-diaphorase system (*2*). This effect has been attributed to competitive action between tetrazolium and the oxidases as hydrogen acceptors (*4, 7*). There is also evidence of toxic effects on several tissues by tetrazolium salts or the process of tetrazolium reduction (*7, 10–14*). In studying the mechanism of the tetrazolium reaction in seeds, changes in respiratory metabolism were observed that may help to explain these toxic effects.

In the present work, embryos of Clinton oats were soaked 3 hr at 30° C, then split longitudinally through the growing axis, and sliced from the seed with as little adhering endosperm tissue as possible. After the embryo slices were washed and blotted, respiratory measurements were made on 40-embryo samples in 0.05 *M* pH 6.0 phosphate buffer in standard Warburg apparatus. The embryos were exposed to tetrazolium (i.e., 2,3,5-triphenyltetrazolium chloride) for about 25 min before measurements began. Oxygen consumption ($Q_{O_2}{}^{air}$), anaerobic carbon dioxide evolution ($Q_{CO_2}{}^{N}$), and aerobic carbon dioxide evolution ($Q_{CO_2}{}^{air}$) were measured for a 1-hr period and calculated on a μl/embryo × hr basis. Under these conditions rates were linear, and standard deviations were about 0.16 μl. The endosperm tissue adhering to the embryo slice was shown to contribute less than 5% to the total respiration, so that the response observed was that of embryo tissue. The effect of tetrazolium on the respiratory capacity of oat embryos is shown in Table 1. At 0.05% tetrazolium there was a slight inhibition of $Q_{O_2}{}^{air}$ and $Q_{CO_2}{}^{N}$ but a definite stimulation of $Q_{CO_2}{}^{air}$. This change resulted in the appearance of aerobic fermentation and in an increase in the *RQ* ($Q_{CO_2}{}^{air}/Q_{O_2}{}^{air}$) and a decrease in the I/N ratio ($Q_{CO_2}{}^{N}/Q_{CO_2}{}^{air}$). At 1% tetrazolium the increase in $Q_{CO_2}{}^{air}$ remained about the same as at 0.05%, but there was also a significant inhibition of the $Q_{O_2}{}^{air}$ and $Q_{CO_2}{}^{N}$.

TABLE 1

EFFECT OF TETRAZOLIUM ON OAT EMBRYO RESPIRATION

	Control	0.05% tetrazolium	% change	Control	1% tetrazolium	% change
(1) $Q_{O_2}{}^{air}$*	2.30	2.19	− 5	2.27	1.77	−22
(2) $Q_{CO_2}{}^{air}$*	2.20	2.71	+24	2.28	2.94	+29
(3) $Q_{CO_2}{}^{N}$*	2.17	2.02	− 7	2.18	1.55	−29
(4) Aerobic fermentation†	0	0.61	—	0	1.15	—
(5) $RQ = (2)/(1)$	0.96	1.24	—	1.01	1.67	—
(6) $I/N = (3)/(2)$	0.99	0.75	—	0.96	0.53	—

* Av of 4 determinations expressed as μl/embryo × hr.
† Aerobic fermentation = (2) treated − (1) treated × (5) control.

More rapid reduction of tetrazolium under anerobic conditions was also observed with oat embryos. With 1% tetrazolium, the formazan extracted and measured spectrophotometrically after 0.5 and 2 hr in air was only 33% and 55%, respectively, of that in nitrogen. Staining was even more severely inhibited in pure oxygen than in air, especially with oat samples of lowered vitality. With oat embryo slices, this inhibitive effect of oxygen was not due primarily to competitive action, since the formazan produced was equivalent to only about 10% of the decrease in oxygen consumption. It would appear that in the presence of oxygen there is decreased activity of the dehydrogenase systems responsible for tetrazolium reduction.

Similarly, the inhibition of oxygen consumption by 1% tetrazolium (Table 1) would not appear to be due primarily to competitive action. Furthermore, tetrazolium has been found to inhibit the two principal oxidative enzymes of corn embryo homogenates. Cytochrome oxidase, measured colorimetrically (*15*) on the sediment of a high-speed centrifugation, was inhibited 15% and 50% at 0.5% and 1% tetrazolium, respectively; and peroxidase (*16*) in the supernatant was inhibited 35% and 85% at 0.1% and 0.5% tetrazolium.

These data show that under conditions where tetrazolium is used as a hydrogen acceptor it may cause significant alterations in respiratory metabolism. Its effect on oat embryo respiration, in fact, is very similar to that reported on other tissues by agents considered to inhibit the Pasteur effect, such as phenazine, amidine, and guanidine derivatives (*17, 18*) and potassium (*19*). Dickens (*17*) pointed out that several of his most active compounds were quaternary salts with conjugated ring systems, structural features also characteristic of tetrazolium salts. The action of phenosafranine (*20*), as well as of other Pasteur-effect inhibitors, has recently been attributed to interference with transphosphorylation. At present there is insufficient evidence to determine whether tetrazolium acts similarly or whether its influence on the Pasteur mechanism is through its action on oxidative enzymes. The present work, however, indicates that tetrazolium salts may have other effects on respiration than as hydrogen acceptors and that they may be useful in the study of the Pasteur mechanism. Finally, these effects on respiratory metabolism may be the basis for the toxicity of tetrazolium salts observed with some tissues and may affect the usefulness of these compounds as indicators of viability.

References

1. SMITH, F. E. *Science*, **113**, 751 (1951).
2. JENSEN, C. O., SACKS, W., and BALDAUSKI, F. A. *Ibid.*, 65.
3. SMITH, F. G. *Plant Physiol.*, **27**, 445 (1952).
4. BRODIE, A. F., and GOTS, J. S. *Science*, **114**, 40 (1951).

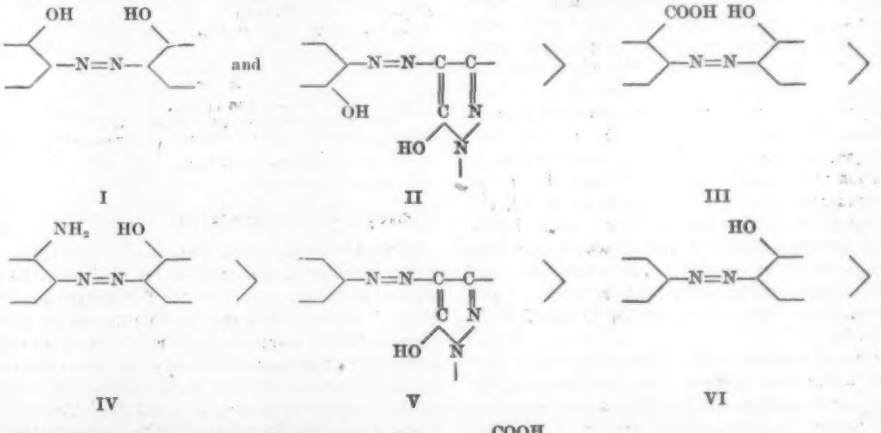
5. KUN, E., and ABOOD, L. Y. *Ibid.*, **109**, 144 (1949).
6. SELIGMAN, A. M., and RUTENBERG, A. M. *Ibid.*, **113**, 317 (1951).
7. RUTENBERG, A. M., GOFSTEIN, R., and SELIGMAN, A. M. *Cancer Research*, **10**, 113 (1950).
8. FRED, B. R., and KNIGHT, S. G. *Science*, **109**, 169 (1949).
9. NARAHARA, H. T., *et al. Trans. N. Y. Acad. Sci.*, ser. 2, **12**, 160 (1950).
10. STRAUB, F. H., CHERONIS, N. D., and STRAUB, E. *Science*, **108**, 113 (1948).
11. KUHN, R., and JERCHEL, D. *Ber. deut. chem. Ges.*, **74B**, 849 (1941).
12. ANTOPOL, W., GLAUBACH, S., and GOLDMAN, L. *U. S. Public Health Service, Public Health Repts.*, **63**, 1231 (1948).
13. SONNENBLICK, B. P., ANTOPOL, W., and GOLDMAN, L. *Trans. N. Y. Acad. Sci.*, ser. 2, **12**, 161 (1950).
14. BISHOP, D. W., and MATHEWS, H. D. *Science*, **115**, 211 (1952).
15. SMITH, F. G., and STOTZ, E. *J. Biol. Chem.*, **179**, 891 (1949).
16. SMITH, F. G., ROBINSON, W. B., and STOTZ, E. *Ibid.*, 881.
17. DICKENS, F. *Biochem. J.*, **30**, 1233 (1936).
18. *Ibid.*, **33**, 2017 (1939).
19. ASHFORD, C. A., and DIXON, K. C. *Ibid.*, **29**, 157 (1935).
20. MCILVAINE, H. *Ibid.*, **46**, 612 (1950).

Manuscript received June 16, 1952.

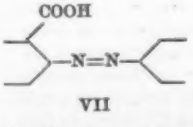
Stabilities of Metal Derivatives of *o*-Substituted Azo Dyes

Fred A. Snavely and W. Conard Fernelius[1]
School of Chemistry and Physics,
The Pennsylvania State College, State College

The coordinating tendencies with metal ions of azo dyes which contain a hydroxyl, amino, or carboxyl group in one or more of the *ortho* positions have been studied in some detail. Such compounds have found many applications in the dying of fabrics (*1*) and in the preparation of organic pigments (*2*). Although numerous investigations have been carried out as to the light fastness, resistance to laundering, etc., of the metal compounds, almost no measurements have been made on the stability of these compounds toward dissociation into their constituent ions.



I II III IV V VI



VII

Formation constants of the metal derivatives (expressed as the general case)

$$M\mathrm{Ch}_{n-1}^{m-(n-1)} + \mathrm{Ch}^- = M\mathrm{Ch}_n^{(m-n)},$$

(where M is the central metal ion, Ch^- is the chelate ion, m is the charge on the metal ion, and n is the number of Ch^- groups) have been measured using the Bjerrum (*3*) technique of potentiometric titration as modified by Calvin (*4*).

The decreasing order of stability of the divalent metal complexes with 4-(2-hydroxybenzeneazo)-3-methyl-1-phenyl-5-pyrazolone, a terdentate group, agrees with those already reported for monodentate and bidentate chelate groups (ammonia [*3, 5*], ethylenediamine [*5, 6*], salicylaldehyde [*5–8*], salicylaldehyde-5-sulfonic acid [*9*], β-diketones [*8, 10, 11*], tropolone [*12*], 8-hydroxyquinoline [*8*], 8-hydroxyquinoline-5-sulfonic acid [*13*], α-amino acids [*13, 14*], and alkyliminodiacetic acids [*15*] and is as follows: Cu > Ni > Co > Zn > Pb > Cd > Mn > Mg > Ca > Sr > Ba. The alkaline earths previously have not been included in such a series, although their noted order is the same as that found by Schwarzenbach (*16*) with iminodiacetic acid and other chelates of the same type.

The decreasing order of stability of the metal compounds of the triply charged metal ions with the aforementioned dye is as follows: Fe > Cr > Al, which is the same as that found by Cooperstein (*17*) with the acetylacetonates.

The relative order of coordination of the dyes with a given metal such as copper (II) is

As the above power of coordination with metal ions falls off, the number of metals which form compounds also decreases, so that the last member of the series

[1] The authors gratefully acknowledge financial aid from The Research Corporation, the Atomic Energy Commission, and The Alrose Chemical Company which has made this investigation possible.

forms a stable complex only with copper (II).

The regularities noted are as follows:

1. In a series of analogous dyes there is a decrease in stability of the metal compounds with increased acidity of the dye.

2. A terdentate group forms a more stable compound than a bidentate group.

3. The hydroxyl group is a stronger coordinating group than the carboxyl group.

4. The simple pyrazolone dyes (Type V), although stronger acids than the simple monohydroxy (Type VI) compounds, form more stable compounds.

References

1. Pfitzner, H. *Angew. Chem.*, **62**, 242 (1950); Wittenberger, W. *Melliand Textilber.*, **32**, 454 (1951).
2. Pratt, L. S. *Chemistry and Physics of Organic Pigments*. New York: Wiley, 75 (1947).
3. Bjerrum, J. *Metal Ammine Formation in Aqueous Solution*. Copenhagen: P. Haase and Sons (1941).
4. Calvin, M., and Wilson, K. W. *J. Am. Chem. Soc.*, **67**, 2003 (1945).
5. Irving, H., and Williams, R. J. P. *Nature*, **162**, 746 (1948).
6. Mellor, D. P., and Maley, L. *Ibid.*, **161**, 436 (1948).
7. *Ibid.*, **159**, 370 (1947).
8. Maley, L. E., Mellor, D. P. *Australian J. Sci. Research*, **2**, 92 (1949).
9. Calvin, M., and Melchior, N. C. *J. Am. Chem. Soc.*, **70**, 3270 (1948).
10. Yamasaki, K., and Sone, K. *Nature*, **166**, 998 (1950).
11. Van Uitert, L. G., Fernelius, W. C., and Douglas, B. E. Unpublished work.
12. Bryant, B. E., Fernelius, W. C., and Douglas, B. E. *Nature*, **170**, 247 (1952).
13. Maley, L. E., and Mellor, D. P. *Australian J. Sci. Research*, **2**, 579 (1949).
14. ———. *Nature*, **165**, 453 (1950).
15. Suder, J. K. and Fernelius, W. C. Unpublished work.
16. Schwarzenbach, G., Kampitsch, E., and Steiner, R. *Helv. Chim. Acta*, **28**, 1133 (1945).
17. Cooperstein, R. Diss., Pennsylvania State Coll. (1952).

Manuscript received June 18, 1952.

Comments and Communications

Alternaria within Pericarp of Wheat Seed

In a communication to *Nature* (*1*) on "The problem of wheat rust," I stated that I obtained *Alternaria* from a majority of fresh and healthy Indian wheat seeds of the current year when they were aseptically treated and planted in culture tubes. From culture of surface-sterilized grains of Barsée wheat (a rust-resistant variety), Miss Hyde (June 1950) observed that the "most common subepidermal fungus is *Alternaria tenuis* (in 64.4% of grains);" she further holds that the subepidermal mycelium apparently arises either from systemic infection of the wheat plant (as in case of *Lolium* spp.) or from fungal spores and hyphae present on the outside of the developing grains and among the dead floral parts. She has not been able as yet, however, to find an instance of actual penetration of the epidermis—the method of entry of the subepidermal mycelium—although she is still trying to find it. From the basal internode (about 1–2 in. long) of flowering stems of Barsée wheat and from stems immediately below the inflorescence, she could get, under aseptic condition in culture plates, *Alternaria tenuis* in 40 and 43 stems out of 70 (*cf.* Table 3, at p. 355, *loc cit.*).

When healthy wheat seeds, aseptically treated, germinated within the culture tubes, sections of the plumules and radicles of healthy wheat seedlings showed the same septate and branched hyphae within their tissues, which in pure culture produced *Alternaria* spores; and, as stated in *Nature*, "repeated isolation of mycelium of *Alternaria sp.* from surface-sterilized seeds indicated that the fungus remained within the seed tissues." Christensen (*3*) seems to hold *Alternaria* mostly to be a storage mold in the case of high-grade wheats. But it is clear (*4*) that he definitely holds *Alternaria* to be "of no known significance in the deterioration of stored seed." Now, of the two alternatives left (i.e., parasite and symbiont), *Alternaria* obviously cannot be a parasite within the seed pericarp of all the healthy wheat plants of the world. Hence, I hold that there can be no other conclusion than that *Alternaria* should be regarded as a symbiont and that further work on eradication of wheat rust should proceed along this new line.

S. R. Bose

Department of Botany
Carmichael Medical College
Calcutta, India

References

1. Bose, S. R. *Nature*, **166** (1950).
2. Hyde, M. B. *Ann. Applied Biol.*, **38** (1951).
3. Christensen, C. M. Personal communication (July 3, 1950).
4. ———. *Cereal Chem.*, **38** (1951).

Zoological Nomenclature

Notice is hereby given that, as from April 15, 1953, the International Commission on Zoological Nomenclature will start to vote on the following cases in the Class Aves, involving the possible use of its plenary powers for the purposes specified in brackets against each entry. Full particulars of these cases were published on October 15, 1952, in the *Bulletin of Zoological Nomenclature*, in Triple-Part 1/3 of Vol. 9.

(1) *Colymbus* Linnaeus, 1758, and *Gavia* (all uses prior to *Gavia* Forster, 1788) [suppression]; (2) *caspicus* Hablizl, 1783, *Colymbus* [suppression]; (3) *cafra* (*Otis*), *cafer* (*Cuculus*), *sulphuratus* (*Cuculus*), *flavescens* (*Lanius*), all of Lichtenstein, 1793 [suppression]; (4) *nortoniensis* Gmelin, 1789, *Fringilla* [suppression]; (5) *natka* (*Lanius*) and *septentrionalis* (*Lanius*), both of Gmelin, 1788, and *eimeensis* (*Columba*), *unalaschkensis* (*Hirundo*), *borealis*

(*Motacilla*), *cirrhatus* (*Pelecanus*), *australis* (*Sterna*), all of Gmelin, 1789 [suppression]; (6) *phaeus* (*Turdus*), *elegans* (*Motacilla*), *chlorotis* (*Muscicapa*), all of Forster, 1794, and *novaehollandiae* Latham, 1790, *Muscicapa* [suppression]; (7) *Pyrrhocorax* Tunstall, 1771 [validation, for the chough]; (8) *philomelos* Brehm, 1831, *Turdus* [validation, for the song thrush]; (9) generic name *Vermivora* and trivial name *lutea* (*Muscicapa*), *pensylvanica* [sic] (*Passer*), *americ.* [sic] (*Vermivora*), all of Linneaus, 1776 [suppression]; (10) *migratoria* Linneaus, 1776 *Columba* [validation, for the passenger pigeon]; (11) *Bubo* Duméril, 1806, *Coturnix* Bonnaterre, 1790, *Egretta* Forster, 1817, *Oriolus* Linnaeus, 1766, [validation, by suppression of senior homonyms published by Brisson in 1760]; (12) *Capella* Frenzel, 1801 [validation, by suppression of *Gallinago* Brisson, 1760]; (13) *Myiobius* Darwin, 1839 [validation and designation of type species]; (14) *cyanea* Hume, 1877, *Muscitrea* [validation, by suppression of *cyanea* Vieillot, 1818, *Muscicapa*]; (15) *ferruginea* Hodgson, 1845, *Hemichelidon* [validation, by suppression of *ferruginea* Merrem, 1784, *Muscicapa*].

Comments on the above cases should be sent as soon as possible to the undersigned.

FRANCIS HEMMING

International Commission on Zoological Nomenclature
28 Park Village East, Regent's Park, London, N.W. 1, England

Color in Trilobites of Trenton Age

IN 1949, a slab of Trenton limestone was picked up from an outcrop beside Route 12, southeast of Watertown, N. Y. It appeared to be a typical, fossiliferous fragment. Recently, however, its dusty surface was cleaned under cold tap water with a nylon bristle brush, without any other cleansing agent, and the monotone mass of fossils suddenly showed bright shrimp-pink spots. Not only did the two recognizable fragments of carapaces develop this color, but numerous fragments, unrecognizable when dry, were identified as carapaces by the color change. Upon drying, a faint tinge of color was retained by the two larger fragments as long as the air remained humid, but the rest faded again into the gray background, to regain color only upon rewetting.

The rock is a somewhat argillaceous limestone with a brownish-gray ground mass. It appears to represent a strand phase of deposition, as the fragments are small and well sorted as to size. The trilobites appear to be *Calymene senaria* and are represented by shed and broken carapaces. The brachiopods show well-preserved but separated valves, mainly of *Plectambonites sericeus* and less abundant *Dalmanella testudinaria*. The crinoid stems have been recrystallized and appear white at the ends of the broken segments. Four varieties are present, but no crinoid heads were found except one too fragmentary for identification. The stems are broken into single disks to lengths of 8–10 segments. The bryozoa are also broken, but none of the fragments is markedly worn, and detail is excellent.

There has been some infiltration of iron-bearing water between the close-packed layers and along joint planes, but the color is the normal red of iron oxide and not the same as that in the wet trilobites. Traces of the iron oxide remain when dry, especially about the joint cracks, but none was noted on the surface of the slab.

In discussing the matter with H. N. Coryell, it was learned that some trilobites in the Cincinnati area, from the Upper Ordovician or Lower Silurian, are pinkish in color, but no mention of color in any trilobites has been found in the literature.

The presence of color presents several possibilities. First, the chitinous carapaces may have absorbed selectively dissolved material in the ground water, which calcareous fossils let pass without change. The color of the absorbed material may have been modified in the process of addition to the chitin. Second, the pink may be the residual, natural color of a shed, sun-baked carapace, such as is seen in crab carapaces on modern beaches. Third, this may be the residual color of living trilobites, in seas as colorful as those of today.

The second possibility would indicate a crustacean characteristic of long standing. The third possibility might indicate that the browns, greens, grays, and mottlings of modern crustaceans are an overlay upon the primitive pink. It may be that the pink in modern forms is now restored only by boiling or sun-baking after death.

No study has been made of this matter beyond the observations and description reported here. This note is presented as a suggestion for further study by paleontologists and, perhaps, biologists.

M. W. GARRETSON

84 Carthage Road, Scarsdale, New York

On Certain Problems of Taxonomists

IN a recent communication (SCIENCE, **116**, 152 [1952]) R. I. Smith has discussed one of the problems of the use of names for experimental animals. This suggests to us another problem, which is frequently not recognized by physiologists and ecologists when trying to obtain identification of their experimental material.

The great majority of systematists (especially in marine groups) are not working at this discipline for a living but practice it on their own time. Only the museum specialists belong to the happy, fortunate band of those chosen to practice systematics for a living, and they are too often snared in red tape. In some groups, which may be favorite experimental or critical ecological material, identifications are exceedingly difficult and the number of competent specialists is very small. Furthermore, almost every specialist is loaded up with collections he has obligingly agreed to identify for some ecologist or research institution,

or he is continually being asked to make such identifications. If systematists were well organized and of ill-will, they could well bring much ecological and some physiological work to a near standstill by balking at these requests. Suppose the shoe were on the other foot. What would the physiologist say to a request from a taxonomist which went something like this: "Under seperate cover I am sending you some specimens of *Exus yus*, the salinity tolerance of which I would like to have ascertained at your convenience"? Or, an ecologist, to: "Please provide an account of the position of these specimens in the Eltonian pyramid"?

The problem of how to compensate a systematist for the service of identifying species in a group that has taken him years to master has recently troubled curators at the U. S. National Museum. It has begun to be apparent that it is unfair to burden an obliging specialist with such work, and that many of them now have more than they can handle. The alarming decrease in taxonomists is in part to blame for this situation, which further aggravates the shortage of taxonomists in a vicious circle. However, how can one estimate what the fair fee for naming material should be? Should it be on a per diem basis, or so much per specimen, or by permitting the specialist to sell the types? And who should pay these fees? The individual researcher, or his institution? Or could payment by arranged on the basis of release from academic or investigational duties by the institution that employs the systematist?[1]

Obviously, we need more systematists than we have, and expressions from bystanders such as Smith are all to the good. They emphasize the need for more enlightened employment of taxonomists, for greater salary budgets for museums, especially our hopelessly understaffed National Museum, and for more enthusiastic acceptance of budding systematists as Ph.D. candidates in our graduate schools. Further, they emphasize the need for really useful monographs of particular groups, which can be achieved only if systematists are allowed to pursue their work without the interruption of extraneous duties. (Were we full-time practitioners of our specialties we would not, of course, consider the requests of physiologists and ecologists as extraneous to our work.) Perhaps it might also be well to consider the endowment of posts specifically for monographers, whose sole duty it would be to produce monographs, with adequate provision for printing their work. But that is another story.

JOEL W. HEDGPETH
ROBERT J. MENZIES
CADET H. HAND
MARTIN D. BURKENROAD

8602 La Jolla Shores Drive
La Jolla, California

[1] The possibility of establishing a closed union or guild of taxonomists, with set fees for identification services (with a special charge for naming new species after the collector), may be worth careful consideration. The writers would welcome suggestions.

Survival of Microfilariae of *Dirofilaria immitis* in Rats and Mice

DURING an investigation dealing with canine filariasis, measured quantities of blood containing known concentrations of the microfilariae of *D. immitis* were injected subcutaneously and intraperitoneally into rats and mice. In both series viable microfilariae were found in the peripheral blood at least three weeks following injection. Although Fulleborn (in Kolle and Wasserman. *Handbuch Pathologisch. Mikroorganism.*, 6, 1044 [1929]) performed one similar experiment, he did not report the findings in detail. In addition to determining the longevity of these larval forms in an unnatural host, the present experiments raise the possibility of utilizing infected rodents for screening filaricidal agents. Further information will be reported in a subsequent publication.

PHILLIP H. MANN
ITALO FRATTA

Department of Animal Care
College of Physicians and Surgeons
Columbia University

Device for Transporting Kymograph Papers

CARRYING long kymograph papers between the smoking apparatus and the kymograph is a perennial problem in physiology and pharmacology laboratories. The apparatus for smoking and shellacking the papers is usually at some distance from the laboratory, and the common practice requires two people to slip the paper off the smoking apparatus and to walk carefully in lock step, maintaining the paper taut between their upraised hands. The return trip is even more hazardous in view of the value of the records on the kymograph paper.

Fig. 1 shows a simple device that has been used in this laboratory with complete satisfaction for the past three years. The dimensions are not critical and should be selected to fit the particular needs of a given laboratory. Basically, the device consists of two wooden bars *A* and *B*, approximately ¾″×1″, which slide through two brass guides *C* and *D*. Guide *D* is provided with a wing-nut thumbscrew for clamping the bars in a given position of extension. On one end is

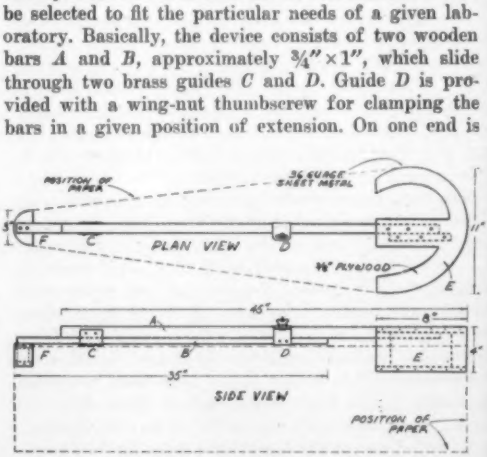


FIG. 1.

a larger ellipsoidal paper support *E*, and at the other is a smaller semicircular support *F*.

In lieu of thumbscrews a simple alternative mechanism may be used to maintain constant tension on the kymograph paper. A length of coil spring or rubber tubing connects the outer end of wooden bar *A* to the inner end of wooden bar *B*. The tension exerted will tend to increase the length of the apparatus. The length and elasticity of the spring or tubing, as well as the points of connection on the bars, are adjusted to conform with the anticipated length of the kymograph paper. To mount the paper, the device is shortened (which increases the tension in the spring) and slipped into the smoked paper, as described below. The spring is then allowed to extend the bars. This simple, constant tension arrangement obviates the necessity of manipulating thumbscrews.

In the use of the device, the coating of smoke is applied to the paper, and the paper is loosened on the drums and slipped halfway off. The carrier is inserted between the ends of the paper thus exposed, with the larger drum on the bottom and the smaller one on the top. Sliding the two bars and tightening the thumbscrew makes the paper taut, yet easily removed from the smoking drums. It can then be carried by means of the device to the kymograph, the device inverted, and the paper first slipped over the large driving drum. Then the smaller kymograph drum is moved to full extension, allowing the paper to be retained on the kymograph. The thumbscrew of the device is loosened and removed from the paper. After this maneuver the final adjustments of the paper on the kymograph drums are made. After the completion of the kymograph recording, the operation is carried out in reverse and the paper is transported back to the smoking apparatus for shellacking.

AKIRA HORITA
THEODORE C. WEST

Department of Pharmacology
School of Medicine, University of Washington

Book Reviews

Microscopic Histochemistry: Principles and Practice. George Gomori. Chicago: Univ. Chicago Press, 1952. 273 pp. Illus. $6.00.

Microscopic Histochemistry is the first comprehensive review of both the theoretical bases and practical applications of the microscopic methods of histochemistry to be published since the classic but superannuated *Histochimie Animale* of Lison. Histochemistry is a relatively young laboratory discipline which deals with the identification and localization of the chemical constituents of cells and tissues. It embraces a variety of techniques that in general fall into two groups: (1) microchemical, the analysis of small amounts of tissue or isolated cellular components by modified biochemical procedures, and (2) microscopic, the characterization of chemical compounds in morphologically intact cells or tissues by such physical properties or chemical reactions as may be visualized with a microscope. This text is concerned only with the latter methods.

Dr. Gomori has divided his discussion into two parts: the first, a brief consideration of the general problems involved in microscopic methodology, including a commentary on the limitations and pitfalls likely to be encountered; the second, an extensive and systematic review of the various methods for demonstrating particular tissue components. In the latter section, each method is critically evaluated, and, in many instances, the author includes considerable information not previously published. Detailed directions are given for the procedures the author has found to be most satisfactory in his own experience.

As an acknowledged leader in the development of histochemical technique, Gomori is eminently qualified to write authoritatively on this subject—and indeed has done so. His presentation, however, can be understood with an elementary knowledge of inorganic and organic chemistry and is annotated with more than 1000 references to the original sources. The methods described do not require special apparatus and can be applied by anyone familiar with the routine procedures of histology.

Microscopic Histochemistry will be invaluable as a reference book for the cytologist, histologist, or pathologist interested in the chemical morphology of cells and tissues, and should also be of interest to other microscopists as a supplement to the more general handbooks on technique already in use.

WILLIAM B. ATKINSON

Department of Anatomy
University of Cincinnati College of Medicine

The Advance to Social Medicine. René Sand; R. W. Parnell, Ed.; Eng. trans. by Rita Bradshaw. New York–London: Staples Press, 1952. 655 pp. $8.50.

This scholarly volume by a distinguished proponent of the social uses and implications of medicine in its full range of services for the sick, and as an instrument of disease prevention and health promotion, reveals a lifetime of devotion, unusual industry, and tenacity of purpose. The 590 pages of economically phrased text, richly supplemented by generous footnotes, deals with practically all recorded civilizations and the history of science of nations around the world. The author quotes from many ancient and modern physicians, prophets, and philosophers.

The remarkably well-documented text is followed

by nine pages of bibliography of a general nature only, as used by the author in writing the present study. There are a 30-page index of place names, peoples, and subjects treated and an index of personal names of 25 pages more.

The plan of this reference book is simple and calls for no particular criticism—unless it be an expression of regret that the author's story of the first use of the term "social medicine" in 1898 by Jules Guérin does not begin until page 507, and is followed by some pages of recent and contemporary history in which the reader must choose for himself just what the term implies.

There are nine parts, or topical chapters, of which the first eight (506 pp.) are devoted to good, condensed histories of the medical profession, hospitals, personal hygiene, public health, social hygiene, industrial medicine, social assistance, and studies of man, leaving the last part (81 pp.) for "the advance to social medicine," in which the variegated picture of development in Europe, the British Commonwealth, the United States, and Japan occupies 40 pages.

On page 554 an effort at definition is made as follows:

> Medicine in the broadest acceptation of the word comprises everything taught in medical schools—the basic sciences, the clinical branches and hygiene. This is the interpretation placed upon it here because social medicine draws its substance from all these sources. . . . The branch of medicine with which we are concerned is social in both . . . the general, and a restricted sense because it pursues on the one hand the good of the community at large, on the other . . . making good the deficiencies of medical care, food, housing, and clothing in those classes of society which can not completely satisfy their requirements by their own efforts.

The late Sir John A. Ryle, the first Nuffield professor of social medicine at Oxford is quoted as follows:

> Social medicine means what it says. It embodies the idea of medicine applied to the service of man as *socius*, as fellow, or comrade. It embodies also the idea of medicine applied in the service of *societas* or the community of men, with a view to lowering the incidence of all preventable diseases and raising the general level of human fitness.

Social medicine is presented as a philosophy, a social point of view of health and disease in the human individual and in the group. In 1935 Sand voiced his own meaning as follows: "Social medicine is the art of prevention and cure considered, in its scientific basis as well as in its individual and collective applications, from the point of view of the reciprocal relations which connect the health of man with his living conditions." We are reminded of Sir George Newman's opinion that "social medicine existed even before history began and its emergence today is simply the result of its evolution from a negative to a positive force."

What we have developed in the United States under the name of public health services are generally referred to by Sand as social hygiene in the European, or continental, sense. The physician of the United States will find the creed or philosophy of social medicine as Sand proposes it rather heavily loaded with emotion. We are told that the advent of this new positive evolution of medicine in a complicated society is inevitable—with an origin to be traced back to prehistoric times.

This book is devoted to relating and reviewing the origins of social medicine. No evidence is offered of the failures chargeable to the multifarious attempts to put social medicine into effect by compulsory laws, and the creation of prepayment and so-called health insurance projects, especially among European nations. We need another and more critical volume by an equally erudite author who will reveal the social experience of some Occidental nations with morbidity, mortality, and personality development where political, financial, and professional factors have not favored the advance to social medicine as presented so persuasively by Professor Sand.

HAVEN EMERSON

156 E. 79th St., New York

The Principles of the Control and Stability of Aircraft. W. J. Duncan. New York–London: Cambridge Univ. Press, 1952. 384 pp. $8.00.

This text is concerned principally with the development of the general methods used to determine the dynamic and static stability of an airplane. From simplified dynamics, such as the rapid incidence adjustment, plugoid motion, and pure rolling, one is taken through the derivation of the dynamic equations of motion of a rigid aircraft, the separation into the symmetric and antisymmetric equations, and their solutions following the classical methods. Some mention is made of the operational approach. Typical numerical solutions are included for the roots of the longitudinal motion with controls fixed. More discussion of the solutions to show in detail the character of the long and short oscillation, and of the lateral modes, would aid the student considerably in understanding the processes involved in each of these motions and approximations that can be made for them.

The dynamic, longitudinal stability analysis leads to the static stability in the general sense, where the force and moment coefficients may be dependent on airspeed as well as on angle of attack. This approach to static stability brings out its full significance, often missed in the approach from statics alone. There is a chapter dealing with the concepts of and relations among the control fixed and free neutral points, maneuver points, and static margins.

The longitudinal trim problem is essentially bypassed, although it is an important aspect of control. No mention is made of body pitching moments or of downwash from flapped wings or of ground effects—things that determine the forward boundary of the useful center of gravity range.

The various methods of investigating the effects of structural flexibility on the dynamic stability are amply discussed, as well as methods of allowing for combined distortion and compressibility, the latter an extension of the general static stability mentioned previously.

The student and the practicing engineer will find the book a fairly comprehensive treatment of the subject.

JOSEPH BICKNELL
Daniel Guggenheim Aeronautical Laboratory
Massachusetts Institute of Technology

Statistical Theory with Engineering Applications. A. Hald; trans. by G. Seidelin. New York: Wiley; London: Chapman & Hall, 1952. 783 pp. $9.00.

This book is well named, for the primary emphasis is on theory. The book is written for those who have had a standard course in differential and integral calculus. Although it would seem to be clearly within the reach of such students, a course in advanced calculus would be a real help to one who wished to follow all the derivations. Proofs are given for practically all the important developments. The author has avoided the use of characteristic functions and higher algebra in order to make the book available to a larger group.

To illustrate the theory, there are many numerical examples using engineering data. Data from non-engineering fields are also given to exemplify some of the theory. One might wish for more of the engineering background from which the data were derived, but more can hardly be expected in a book with the main emphasis upon theory. A serious deficiency in the book, as a textbook, is that there are no problems at all.

In the nearly 800 pages there is a very complete coverage of standard topics, such as significance tests, linear and multiple regression, and analysis of variance, as well as some topics not too commonly available. This subject matter is more directly of interest to the research engineer, rather than to the industrial engineer. Thus there is almost no emphasis upon acceptance sampling, either for measurements or attributes, nor upon control charts, which are tools of basic importance to the industrial man. It is true that most of the supporting theory of these methods is to be found somewhere in the book. But it is not all together, summarized and illustrated. Furthermore, there is almost no coverage of sequential analysis, which is useful both to the industrial man and to the research engineer. Finally, there is, from this reviewer's standpoint, too little emphasis on the higher moments of a distribution. For example, the very useful Pearson Type III curve is scarcely mentioned.

The foregoing omissions are, however, not too serious except for the industrial engineer. An author simply cannot cover everything, and the book is nearly 800 pages without this material. It should be a most valuable book for the research engineer and physical scientist, as well as for those working in other fields.

The book is clearly written—in fact, it is a remarkable job of translation. This reviewer found almost no typographical errors and none of any consequence. It is well illustrated by curves and graphs, and the proofs are compact but clear. A glossary of symbols with page references is given to help in the always difficult matter of statistical notation. It has a wealth of references.

There are no statistical tables, such as those for the t-distribution. These are all given in an auxiliary book (*Statistical Tables and Formulas*, 97 pp., $2.50) by the same publisher.

Altogether, the book is a most welcome addition to statistical literature.

IRVING W. BURR
Statistical Laboratory, Purdue University

Prelude to History: A Study of Human Origins and Palaeolithic Savagery. Adrian Coates. New York: Philosophical Library, 1952. 289 pp. Illus. $4.75.

In his preface Mr. Coates says: "This is not a book for the specialists and experts, though I hope they will not despise it." I have heard this book discussed by a number of specialists and experts in prehistoric archaeology, whose identities I shall not reveal. They do not despise it. Some of them even think it useful. But none of them chooses to say much about it.

Mr. Coates appears to be a man who has read profoundly. With all the references, new and old, at his fingertips, he can tell you exactly what everyone of consequence has said at any given moment. For that reason his work is a splendid intelligence report on the field of paleolithic archaeology, up to the turn of the half-century. He has, furthermore, read physical anthropology, primate behavior, ethnography, and psychology, over a classical background. He is an eminently well-educated man and he writes well.

The trouble is that, as Coates, he has not much to say. We are told that Julian Huxley said this and Gordon Childe said that. Even Coon said some things in 1939, which he would hesitate to repeat in 1952, but Coates does not know this. He lives in a world of books, not of men. That is why the experts have little to say about *Prelude to History*.

This silence is perhaps a pity, since the educated layman needs a well-written résumé of current archaeological knowledge, along with current theory, and there seems to be no other place where he can get both, in such abundance and clarity, for $4.75. It is also a pity that a man who has read so widely does not know that chipped flint balls from the lower paleolithic of Algeria could hardly have been used for stone-boiling. What is worse, he deduces from the existence of these few balls that "fire was also used from the earliest time for cooking" (p. 90). Boiling of any kind is a technique still unknown to the more primitive hunters today. There is no evidence whatever that the people who made the flint balls cooked at all, or even had fire. This example reveals a principle

—that no amount of book learning can take the place of field work and the privilege of chatting and corresponding informally with one's fellow-professionals. It is a pity that a dirt archaeologist who has these privileges cannot cover the ground with equal literary facility. Perhaps someday this miracle will take place and the intelligent layman will get the genuine article. In the meantime, with strong reservations in the interpretive field, this is a working substitute.

CARLETON S. COON
University of Pennsylvania Museum

Frost Action in Soils: A Symposium. Presented at the Thirtieth Annual Meeting, January 9–12, 1951. Highway Research Board, Special Rept. No. 2. Washington, D. C.: National Research Council, 1952. 385 pp. $3.75.

This book discusses problems related to the freezing and thawing of soils—a branch of the young science of soil mechanics. It contains 39 papers written by 48 men, mostly engineers connected with highway departments, railroads, the Corps of Engineers, or educational institutions; but geologists, geographers, botanists, physicists, and soil scientists are represented. Canada contributed two papers, Norway two, England one, and the United States 34. These facts account for inevitable differences of opinion and widespread duplication of research.

The papers are grouped under six headings: "Climate and Distribution of Soil," "Soil Temperature and Thermal Properties of Soils," "Basic Data Pertaining to Frost Action," "Frost Action and Spring Break-up," "Remedies and Treatment," and "Needed Research."

Most of the authors agree that frost heaving is due to growth of ice crystals, often arranged in more or less well-defined layers, rather than to volume change accompanying change of state. Water is fed by capillary forces to growing crystals where soil is sufficiently fine-grained and where the capillary fringe above the water table extends into the freezing zone. Silts and, to a lesser extent, clays are susceptible to frost heave. Engineers define clays on the basis of particle size instead of mineral composition. One author, a geologist, emphasizes that the water-holding properties of the various clay minerals can affect the physical properties of soils. With modern methods of highway construction, pavements suffer less from heaving than from excessive amounts of water liberated by spring thaws.

An effective although expensive preventive method is replacment of susceptible soils with gravel, crushed stone, sand, cinders, or (in Norway) peat. Drainage, or raising highways above the general surface, is common practice. Calcium chloride prevents objectionable heaving, but the effects are not permanent.

Formulas are developed for predicting subsurface temperatures and the depth of freezing and thawing, but this problem is complicated by the variability of several factors. One writer estimates that it takes at least 22.7 years for heat from the earth to thaw a foot of permafrost upward from the bottom.

Typographical errors are common: titles under two diagrams are interchanged; some figures are illegible because of excessive reduction; and one paper having 35 illustrations refers to none of them directly by number. Absence of the jargon associated with "cryopedology" is refreshing. Although the book contains valuable information and some excellent papers, it does not come up to standards desirable in publications sponsored by the National Academy of Sciences and the National Research Council.

STEPHEN TABER
Geology Department, University of South Carolina

Scientific Book Register

The History of American Epidemiology. Sponsored by the Epidemiology Section, American Public Health Association. C.-E. A. Winslow *et al.*; Franklin H. Top, Ed. St. Louis: Mosby, 1952. 190 pp. Illus. $4.75.

Die Wuchsstofflehre: Ergebnisse und Probleme der Wuchsstofforschung. Hans Söding. Stuttgart: Georg Thieme, 1952. 304 pp. Illus. DM 33.

Development of the Guided Missile. Kenneth W. Gatland. London: Flight Pub.; New York: Philosophical Library, 1952. 133 pp. Illus. $3.75.

Psychiatry and the Law. Manfred S. Guttmacher and Henry Weihofen. New York: Norton, 1952. 476 pp. $7.50.

Traité de Zoologie: Vol. I, ***Phylogénie, Protozoaires: Généralités, Flagelles.*** Pierre-P. Grassé, Ed. Paris: Masson et Cie, 1952. 1071 pp. Illus. 9000 fr.; 9600 fr. bound.

Annual Review of Nuclear Science, Vol. 1. Stanford, Calif.: Annual Reviews, 1952. (Published in cooperation with the National Research Council.) 645 pp. $6.00.

Design for a Brain. W. Ross Ashby. New York: Wiley, 1952. 260 pp. Illus. $6.00.

Organic Chemistry: The Chemistry of the Compounds of Carbon. 2nd ed. Lucius Junius Desha. New York–London: McGraw-Hill, 1952. 595 pp. Illus. $6.50.

Vergleichende Physiologie: Sinnesphysiologie, Band I. 3rd ed. W. von Buddenbrock. Basel: Verlag Birkhäuser, 1952. 504 pp. Illus. Cloth, 45.75 Swiss fr.; paper, 41.60 Swiss fr.

Pasture Production and Management. R. H. Lush. New York–Toronto: Blakiston, 1952. 193 pp. Illus. $3.75.

The National Health Service in Great Britain: An Historical and Descriptive Study. James Stirling Ross. New York: Oxford Univ. Press., 1952. 398 pp. $7.00.

Mesons: A Summary of Experimental Facts. Alan M. Thorndike. New York–London: McGraw-Hill, 1952. 242 pp. Illus. $5.50.

Elasticity in Engineering. Galcit Aeronautical Series. Ernest E. Sechler. New York: Wiley; London: Chapman & Hall, 1952. 419 pp. Illus. $8.50.

Man the Chemical Machine. Ernest Borek. New York: Columbia Univ. Press, 1952. 219 pp. $3.00.

The Indian Tribes of North America. Smithsonian Institution, Bureau of American Ethnology, Bull. 145. John R. Swanton. Washington, D. C.: Supt. of Documents, GPO, 1952. 726 pp. and maps. $3.50.

INTERSCIENCE

CRIME INVESTIGATION - Physical Evidence and the Police Laboratory

By PAUL L. KIRK, Professor of Biochemistry and Criminalistics, University of California

Ready January 1953. 806 pages, 151 illus., 21 tables. $10.00

This book is organized in two parts: Physical Evidence in General Criminal Investigation, and Laboratory Operations and Techniques.

The first part is written with the need of police investigators, general criminalists in the smaller police laboratories, and students of criminalistics and police in mind. It follows the physical evidence from the scene of the crime via the police laboratory to the courtroom, and teaches how to collect, preserve, evaluate, and present it.

The second part is an introduction into the operation of the criminalistic field laboratory. It presents a collection of methods that have been found useful and reliable in the author's laboratory in investigating a wide variety of crimes. The author, a professor of criminalistics and biochemistry at the University of California at Berkeley, is well known through his investigations in the field of microchemistry and ultramicrochemistry. He is using his broad knowledge and wide experience of chemical and physical methods to give a scientifically sound and, at the same time, practical presentation. The book is of special interest to analytical and bio-chemists and to chemical, biological, and clinical laboratories.

CRYSTAL STRUCTURES

By RALPH W. G. WYCKOFF, Laboratory of Physical Biology, National Institutes of Health

Published in sections in loose-leaf sheets to be placed into binders. Supplements will be supplied to each chapter at irregular intervals.

To be published in early 1953:

SECTION III: Chapter XIV. The Structure of Benzene Derivatives. Chapter IV. The Crystal Structures of Alicyclic and Heterocyclic Compounds and of Carbohydrates. Index to Chapters XIV and XV.

SUPPLEMENT II: Additions to Chapter XIII

Previously published:

SECTION I: Chapters I–VII. 1948. 256 text pages, 66 illus., 122 pages of tables. $8.00

SECTION II: Chapters VIII–X, XIII. 1951. 253 text pages, 74 illus., 256 pages of tables. $10.00

SUPPLEMENT I: Additions to Chapters I–X. 1951. 72 text pages, 64 pages of tables. $4.00

"This monumental work is a necessary reference for all crystallographic workers. Crystallographers owe a great debt of gratitude for Dr. Wyckoff's efforts in assembling it."—HORACE WINCHELL in *American Journal of Science*

CHEMICAL ANALYSIS OF INDUSTRIAL SOLVENTS

By MORRIS B. JACOBS, Chief Organic Chemist, Department of Health, City of New York, and LEOPOLD SCHEFLAN, Technical Manager, "Hadar" B. Scheflan, Ltd., Tel Aviv, Israel.

Ready February 1953. 510 pages, 46 illus., 43 tables. Approx. $10.00

The increasing use of solvents and plasticizers and the refinements of recovery processes have made solvent analysis and solvent control an important part of laboratory and plant procedures. In addition, wider application of solvent mixtures has posed new problems for the analytical chemist. As in all fields of organic analysis, however, the information on solvent analysis has been widely scattered and not easily accessible. Dr. Jacobs' most recent book attempts to remedy this situation by a survey of classical and modern methods for assaying, detecting, and determining individual solvents and solvent mixtures as liquids and vapors. Detailed procedures are given for immediate use of the book as a laboratory manual. Physiological effects of solvents are mentioned.

INTERSCIENCE PUBLISHERS, INC. 250 Fifth Avenue New York 1, N.Y.

Are you receiving . . .

THE PERKIN-ELMER
INSTRUMENT NEWS
FOR SCIENCE AND INDUSTRY
VIDEO SCANNING METHODS FOR INFRARED SPECTROMETERS

INSTRUMENT NEWS is an 8-page quarterly published in the interests of furthering research, material analysis, and production through modern optical instrumentation. Articles of technical and general interest are prepared by leading workers in the field and the Perkin-Elmer staff.

Some of the outstanding articles from the Fall '52 issue are:

HANDLING LARGE PIECES OF OPTICAL GLASS
Precision Workmanship at Perkin-Elmer

ISOTOPE DILUTION TECHNIQUE FOR INFRARED
Article by N. R. Trenner

CONTINUOUS PROCESS CONTROL WITH INFRARED
Dispersion vs. Non-dispersion Analyzers

Among subjects in the Summer '52 issue are:

FLAME PHOTOMETRY SPEEDS INFANT BLOOD STUDIES
Ultramicro Techniques with Premature Infants

REPORT ON THE SOUTHERN SKIES
Dr. Bart J. Bok's results with ADH Telescope

INFRARED ASSAYS SIMILAR DRUGS
Smith, Kline & French Case History

You may receive **INSTRUMENT NEWS** regularly *without charge* by filling in the coupon below.

THE PERKIN-ELMER CORPORATION
840 MAIN AVENUE, NORWALK, CONN.
Please send me INSTRUMENT NEWS
NAME ..... TITLE .....
FIRM .....
ADDRESS .....
CITY ..... STATE .....
(Sci.)

Meetings & Conferences

Jan. 12–16. Society of Automotive Engineers (Annual). Sheraton-Cadillac Hotel, Detroit.

Jan. 13–16. Highway Research Board (Annual). National Academy of Sciences–National Research Council, Washington, D. C.

Jan. 14–16. Conference on High-Frequency Measurements, sponsored by American Institute of Electrical Engineers, Institute of Radio Engineers, and the National Bureau of Standards. NBS, Washington, D. C.

Jan. 17. Symposium on Blood (Annual). Wayne University College of Medicine, Detroit.

Jan. 19–23. American Institute of Electrical Engineers (Winter General). Hotel Statler, New York.

Jan. 20–31. Inter-American Congress of Philosophy. Havana.

Jan. 22–24. American Physical Society (Annual). Harvard University, Cambridge, Mass.

Jan. 26–27. Compressed Gas Association, Inc. (Annual). Waldorf-Astoria Hotel, New York.

Jan. 26–29. American Society of Heating and Ventilating Engineers (Annual). Conrad Hilton Hotel, Chicago.

Jan. 26–30. International Heating and Ventilating Exposition. International Amphitheatre, Chicago.

Jan. 27–29. Association of American Soap and Glycerine Producers, Inc. (Annual). Waldorf-Astoria Hotel, New York.

Jan. 30. Public Health Workshop, First District Dental Society of the State of New York. Hotel Statler, New York.

Jan. 30–31. Conference on Protein Metabolism (Annual). Bureau of Biological Research, Rutgers University, New Brunswick, N. J.

Jan. 30–31. Western Society for Clinical Research (Annual). Carmel, Calif.

Feb. 2–4. Symposium in Fundamental Biology. Michigan State College, East Lansing.

Feb. 4–6. Western Computer Conference. Hotel Statler, Los Angeles.

Feb. 5–7. Southwestern IRE Conference and Electronics Show (Annual). Plaza Hotel, San Antonio.

Feb. 12–13. Protestant Hospital Association. Palmer House, Chicago.

Feb. 12–13. Southern Weed Conference. Jung Hotel, New Orleans.

Feb. 15–17. Canadian Ceramic Society. Royal York Hotel, Toronto.

Feb. 16–19. Technical Association of the Pulp and Paper Industry (Annual). Commodore Hotel, New York.

Feb. 16–21. Pakistan Science Conference (Annual). Lahore.

Feb. 18–20. National Cotton Council (Annual). General Oglethorpe Hotel, Savannah, Ga.

Feb. 23–Mar. 10. Commission for Climatology of the World Meteorological Organization. Washington, D. C.

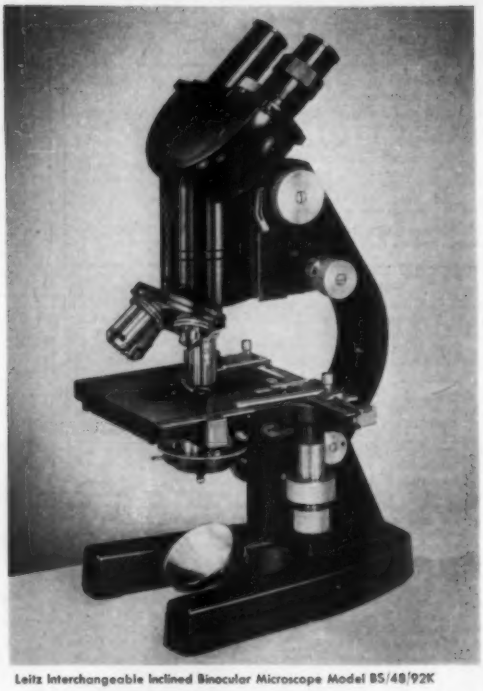
Feb. 24. Society for the Advancement of Criminology (Interim). Northwestern University Law School, Chicago.

Feb. 26–28. American Academy of Forensic Sciences (Annual). Drake Hotel, Chicago.

Mar. 1–6. International Congress of Military Medicine and Pharmacy. Montevideo.

Mar. 2–6. American Society for Testing Materials. Hotel Statler, Detroit.

for Lifetime
accuracy and precision



Leitz Interchangeable Inclined Binocular Microscope Model BS/48/92K

Leitz®

BINOCULAR Medical Microscope

Embodying the latest optical improvements, the Leitz BS Binocular Medical Microscope now has a new streamlined binocular body with 1.25x magnification factor. Traditional Leitz quality assures accuracy and precision throughout a lifetime of hard professional use.

Paired Huyghenian eyepieces 6x and 10x
Interchangeable, inclined binocular tube
New, streamlined binocular body with 1.25x magnification factor
Coarse adjustment by rack and pinion
Fine adjustment on *double ball bearings*
Quadruple, revolving, dustproof nosepiece
Achromatic objectives
16mm. (10x) 4mm. (45x); oil immersion 2 mm. (100x)
Complete with leatherette carrying case

Another of the famous Leitz Microscopes—
recognized *everywhere* as the finest made *anywhere*.

Write for Catalog Micro 1015 — S

E. LEITZ, Inc., 304 Hudson Street, New York 13, N.Y.
LEITZ MICROSCOPES • SCIENTIFIC INSTRUMENTS • BINOCULARS
LEICA CAMERAS AND ACCESSORIES

PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries—at a very low cost

CLASSIFIED: 18¢ per word, minimum charge $3.60. Use of Box Number counts as 10 additional words.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—providing satisfactory credit is established.

Single insertion	$19.50 per inch
7 times in 1 year	17.50 per inch
13 times in 1 year	16.00 per inch
26 times in 1 year	14.00 per inch
52 times in 1 year	12.50 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

POSITIONS WANTED

Histological Technician, A.B. Biology. Six years' experience. Diversified background including animal care; autopsying of hamsters, dogs, plus standard laboratory animals; endocrine assays; histological and histochemical technics. Box 1, SCIENCE. 1/9

Pharmacologist; M.D. Three years' teaching, nine years industrial experience, numerous publications, member FASEB, ACS, AAS, desires research directorship. Box 342, SCIENCE. X

POSITIONS OPEN

Research Chemists, Physicists, Engineers. The following additions to our permanent staff are needed for research on smokeless powder, rocket propellants, detonators, dynamites, and other explosives chemicals. 4 Chemists, 3 Chemical Engineers, Physicist, Mechanical Engineer, Electrical Engineer. Experienced men particularly needed for responsible work: salaries commensurate. Staff positions also available for chemical or mechanical engineer in estimating cost of proposed research processes and in market studies; also research librarian. Desirable insurance, retirement, holiday and vacation plans. Expanding diversified company makes advance possible to various fields. Submit detailed resume including salary requirement. Employment Manager, Olin Industries, Inc., Explosives Division, East Alton, Illinois. 1/16

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

CLASSIFIED: 25¢ per word, minimum charge $6.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—providing satisfactory credit is established.

Single insertion	$19.50 per inch
7 times in 1 year	17.50 per inch
13 times in 1 year	16.00 per inch
26 times in 1 year	14.00 per inch
52 times in 1 year	12.50 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS

Your sets and files of scientific journals are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, INC. Boston 19, Massachusetts

BOOKS

SCIENTIFIC BOOKS and PERIODICALS WANTED
Complete libraries—Sets and runs—Single titles
Also, please send us your want lists.
STECHERT - HAFNER, INC.
31 East 10th St., New York 3

WANTED TO PURCHASE . . .
SCIENTIFIC PERIODICALS and BOOKS
Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted.
WALTER J. JOHNSON • 125 East 23rd St., New York 10, N. Y.

AVOID DELAY . . . . *Cash in Advance payment*
Must be enclosed with ALL classified ads.
See "Charges and Requirements"

PROFESSIONAL SERVICES

FOOD RESEARCH LABORATORIES, INC.
Founded 1922
Philip B. Hawk, Ph.D., President
Bernard L. Oser, Ph.D., Director
Research • Analyses • Consultation
Biological, Nutritional, Toxicological Studies for the Food, Drug and Allied Industries
48-14 33rd Street, Long Island City 1, N.Y.
• RESEARCH
• CONSULTATION
• ANALYSES

LOOKING FOR A PUBLISHER?
Write for Free Booklet SC telling how we can publish your book. All subjects considered. New authors welcome.
VANTAGE PRESS, Inc. • 120 W. 31 St., New York 1.
In Calif.: 6356 Hollywood Blvd., Hollywood 28

WISCONSIN ALUMNI RESEARCH FOUNDATION

LABORATORY SERVICES
in Biochemistry, Chemistry, Bacteriology and Insecticide Testing

Screening of compounds for insecticidal, fungicidal and bactericidal properties
Biological evaluation and chemical determination of insecticides
Peet Grady and C.S.M.A. aerosol tests
Warfarin assays

Write for price schedule

WISCONSIN ALUMNI RESEARCH FOUNDATION
P. O. BOX 2059 • MADISON 1, WISCONSIN

Fight Polio
Join the
MARCH OF DIMES
JANUARY 2 TO 31
FIGHT INFANTILE PARALYSIS

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

PROFESSIONAL SERVICES

New Food Ingredients • New Drugs

ANIMAL TESTS

Analyses • Consultation • Research

LaWall & Harrisson

Bacteriologists
Chemists • Pharmacologists

Div. S, 1921 Walnut St., Philadelphia 3, Pa.

SUPPLIES AND EQUIPMENT

STAINS

STARKMAN Biological Laboratory

• RARE
• COMMON

Price list on Request

461 Bloor St., W.
Toronto, Canada

BLUE SPRUCE FARMS

R. D. 2, Altamont, N. Y.
WHITE MICE . . . WHITE RATS
For Laboratory Use
Telephone: Altamont 4461

TRANSPARENT BOXES

For small OBJECTS & SPECIMENS
Useful in ALL LABORATORIES
Fine for Home Workshops, etc.

Write for New Literature S-TPB

20 for $1.00

R. P. CARGILLE LABORATORIES, Inc.
117 Liberty St. New York 6, N. Y.

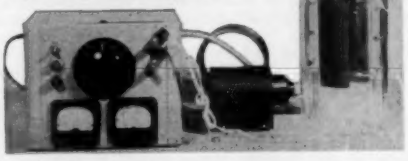
GBI CATALOG No. 677

Lists more than 300 items for Research—Biological, Microbiological, Bacteriological, Biochemical, Nutritional. Write

GENERAL BIOCHEMICALS, INC.

72 LABORATORY PARK • CHAGRIN FALLS, OHIO

ELECTROCONVECTION
for fractionation
of protein mixtures



See:

Proc. Soc. Exp. Biol. Med. v. 81, p. 278 (1952)

Send for free bibliography of electrophoresis-convection

E-C APPARATUS CO. 27 Haven Avenue New York 32, N. Y.

SUPPLIES AND EQUIPMENT

• **HYPOPHYSECTOMIZED RATS**

Shipped to all points via Air Express
For further information write

HORMONE ASSAY LABORATORIES, INC. • 8159 South Spaulding Ave. Chicago 29, Ill.

C. P. AMINO ACIDS
and Peptides
for immediate delivery
H. M. CHEMICAL CO., LTD.
1651 – 18th St. Santa Monica, Calif.

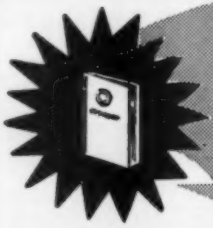
TACONIC FARMS

Germantown, N. Y.
Phone 187 F 2

• Swiss Mice
• Webster Strain

All AMINO ACIDS— natural, synthetic, unnatural, Rare Sugars, Biochemical Products, Reagents, New Pharmaceuticals in stock. Write or phone PLaza 7-8171 for complete price list.

BIOS LABORATORIES, INC. 17 West 60th Street, New York 23, N. Y.



ONE BOOK MAY BE PRICELESS TO YOU

Over 140 foreign periodicals . . . over 700 foreign book reprints . . . ready for delivery at prices even lower than the original through the Edwards Brothers LITHOPRINT process of Book REPRINT.

Here's your opportunity to have access to the great discoveries and advances of the War Years in Europe.

One book may be priceless to you!

SEND FREE CATALOGUES AT ONCE TO

NAME_____

STREET_____

CITY_____ STATE_____

J. W. EDWARDS
ANN ARBOR, MICHIGAN

For simplicity of operation and maintenance, also for

Accuracy

Dependability

Versatility

PHOTOVOLT pH Meter Mod. 125

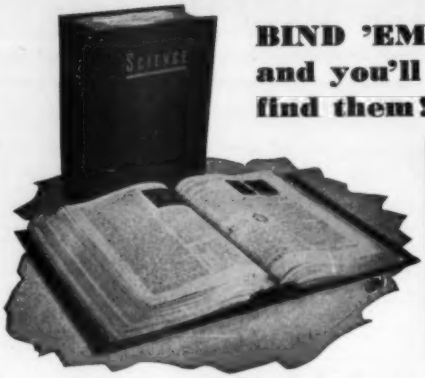
powered by only 3 ordinary radio batteries which give 2000 hours of reliable service

Complete with electrodes and batteries $145.—

Write for literature to

PHOTOVOLT CORP.

95 Madison Ave. New York 16, N. Y.



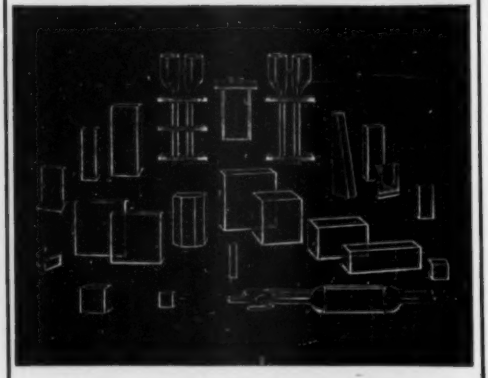
BIND 'EM... and you'll find them!

Keep your copies of SCIENCE always available for quick, easy reference in this attractive, practical binder. Simply snap the magazine in or out in a few seconds—no punching or mutilating. It opens FLAT—for easy reference and readability. Sturdily constructed—holds 26 issues.

This beautiful maroon buckram binder stamped in gold leaf will make a fine addition to your library. Only $2.75 postpaid (personal check or Money Order please). Name, 70¢ extra—year of issue, 40¢ extra. ORDER YOURS NOW!

SCIENCE • 1515 Mass. Ave., N.W., Washington 5, D. C.

GLASS ABSORPTION CELLS made by ***KLETT***



Makers of Complete Electrophoresus Apparatus

SCIENTIFIC APPARATUS

Klett-Summerson Photoelectric Colorimeters—Colorimeters — Nephelometers — Fluorimeters—Bio-Colorimeters — Comparators — Glass Standards—Klett Reagents.

Klett Manufacturing Co.

179 East 87 Street, New York, New York

PITUITARY-ADRENAL FUNCTION

PITUITARY-ADRENAL FUNCTION continues the AAAS tradition of presenting in book form the collected papers presented at symposium programs of wide interest. This volume includes 22 papers delivered at a two-day Symposium on the Adrenal Cortex at the AAAS meeting in New York City, December 1949.

This AAAS symposium volume assembles important contributions of a score of laboratories in the United States and Canada from which many of the recent major advances in pituitary-adrenal physiology and therapeutics have come, and includes studies on the regulation of adrenal cortical activity, the role of the cortical hormones in protein, carbohydrate, and mineral metabolism, and effects of the cortical steroids and the ACTH in various disease states. A summary chapter on "Adrenolescence" by Dr. George Perera forecasts some of the possible future trends in this active field of endocrine research.

6 x 9 inches, illustrated, clothbound,
224 pages—$4.00

Price to AAAS members for prepaid orders—$3.50

Order from:
AAAS, 1515 Mass. Ave., N.W., Washington 5, D. C.

NEW MODEL

INTERNATIONAL CENTRIFUGES

IN OUR STOCK FOR IMMEDIATE SHIPMENT

3027-B. Size 1, Model SBV.

3070-B. Size 2, Model V.

INTERNATIONAL ELECTRIC CENTRIFUGES, New Models, Size 1 Type SBV and Size 2 Type V. Now incorporate, in addition to their many time-proven features and important engineering improvements, the following new features:

Speed Controller. A transformer-type Speed Controller replaces the former resistance rheostat and offers a stepless, uniform speed control throughout the entire range without the troublesome heating and heat radiation encountered with the former type rheostat. The Controller and a 2-hour automatic timer are mounted conveniently on the side of the steel guard.

Sub-Base Mounting. The Centrifuges are now mounted on a permanently attached sub-base equipped with casters and which incorporates specially designed vibration dampeners which provide maximum absorption of horizontal and vertical vibration and prevent their transmission to the laboratory floor. The completely assembled unit is ready for immediate use after attachment to the electric outlet—and insertion of the selected equipment of head, tubes and glassware.

Outside surfaces of both models are finished in a hard, glossy gray enamel, and the inside surface of the guard bowl is white enamelled.

3027-B. **Centrifuge, International Electric, Size 1, Model SBV,** as above described, with welded steel guard bowl, speed controller, automatic timer, and tachometer, integrally mounted on sub-base with casters, but without head, metal shields or glassware. With 6 ft. cord and plug. For 115 volts, 50 or 60 cycles, a.c. only. Current requirement, 6.0 amperes .. 525.00

3070-B. **Centrifuge, International Electric, Size 2, Model V,** as above described, with welded steel guard bowl, speed controller, automatic timer, and tachometer, integrally mounted on sub-base with casters, but without head, metal shields or glassware. With 6 ft. cord and plug. For 115 volts, 50 or 60 cycles, a.c. only. Current requirement, 6.0 amperes 605.00

More detailed information sent upon request.

ARTHUR H. THOMAS COMPANY

LABORATORY APPARATUS AND REAGENTS

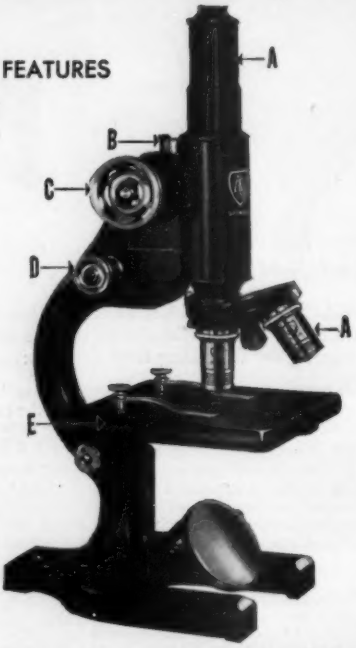
WEST WASHINGTON SQUARE
PHILADELPHIA 5, PA.

Teletype Services: Western Union WUX and Bell System PH-72

IT PAYS TO INVEST IN *Quality*

TEACHING MICROSCOPES

LOOK FOR *ALL* THESE FEATURES



A. FULL CHOICE OF HIGH QUALITY OPTICS

B. ALL-METAL PRECISION FITTED SLIDEWAYS

C. RACK AND PINION COARSE ADJUSTMENT

D. MICROMETER-SCREW TYPE FINE ADJUSTMENT WITH FULL EXCURSION RANGE

E. LONG WEARING BAKELITE STAGE ACCOMMODATES STANDARD AO MECHANICAL STAGES

Schools cannot afford to be constantly replacing or repairing instruments of poor construction and design which quickly wear out or are easily damaged by students. Teaching microscopes must be *both* simple to operate and extremely durable.

The AO Spencer No. 66B Microscope is *identical* in quality of construction to expensive AO laboratory instruments that have won world-wide recognition for precision optics and mechanical durability. Basic elements of this design have been time tested for over 30 years. Although initial cost is slightly higher than the lowest-priced instruments, the 66 will actually *save* you money through reduced replacement and maintenance. Learn *all* the facts before you buy. For information write Dept. O1.

American Optical

INSTRUMENT DIVISION • BUFFALO 15, NEW YORK